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POLLUTION OF THE INTERSTATE WATERS OF THE GRAND CALUMET RIVER, LITTLE CALUMET RIVER, CALUMET RIVER, WOLF LAKE, LAKE MICHIGAN AND THEIR TRIBUTARIES. PROGRESS EVALUATION MEETING HELD AT CHICAGO, ILLINOIS ON MARCH 15, 1967. VOLUME III

Federal Water Pollution Control Administration
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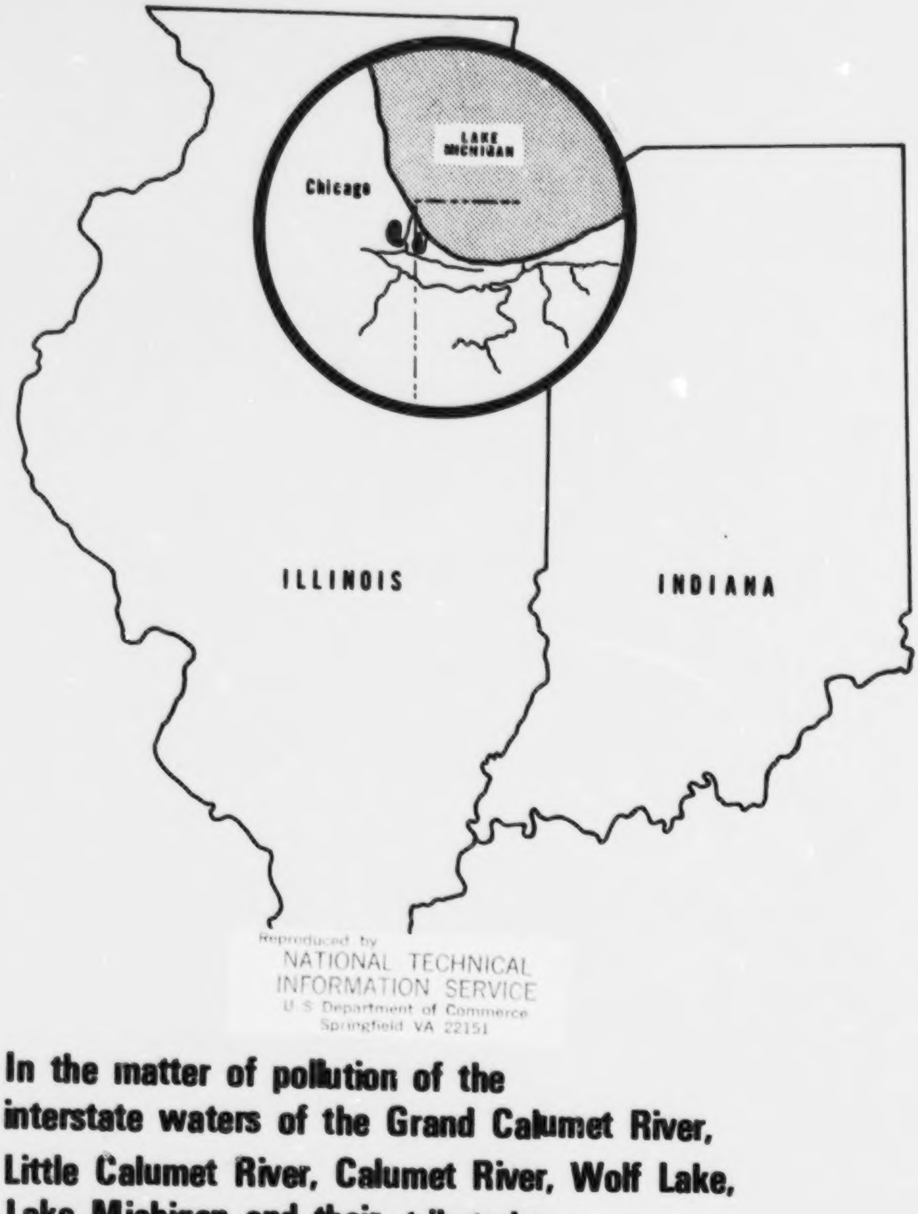
Progress Evaluation Meeting

Volume 3



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In the matter of pollution of the interstate waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and their tributaries

Wednesday, March 15, 1967

U. S. Department of the Interior
Federal Water Pollution Control Administration
CLEAN WATER

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DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

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Conference

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In the Matter of:

Progress Meeting in the Matter of Pollution of the Interstate Waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and Their Tributaries

Wednesday, March 15, 1967
Chicago, Illinois

VOLUME III

I. INTRODUCTION

This report presents a compilation of water quality data collected from the various waterways within The Metropolitan Sanitary District of Greater Chicago. The data was primarily collected within two spans of time: May through October 1965 and June through October 1966. The data presented for the Calumet area is the result of a weekly sampling program covering the period from October 1965 through October 1966. Sampling stations on the Sanitary and Ship Canal at Lemont and Lockport provided data on a daily basis during both 1965 and 1966. Similarly, a daily sampling and analytical program was carried out on the DesPlaines River at Lemont.

For the purposes of this report, the waterways under consideration are divided into various sections as follows:

1. The North Shore Channel (NSC), North Branch of the Chicago River (NBCR) from Wilmette downstream to the junction with the Chicago River.

2. The South Branch of the Chicago River (SBCR) from the junction with the Chicago River downstream through the Chicago Sanitary and Ship Canal (SSC) to the Lockport

Locks and Controlling Works.

3. Sampling stations maintained at Lemont and Lockport on the Sanitary and Ship Canal.

4. The waterways within the designated Calumet area: the Calumet River (CR), Little Calumet River (LCR), and the Cal-Sag Channel (CSC) from Lake Michigan to the junction with the Chicago Sanitary and Ship Canal. This area also includes the lower reach of the Grand Calumet River (GCR).

5. The DesPlaines River in the vicinity of Lemont.

Figure I is a map of the area showing a number of the more important sampling stations. The specific locations where data has been collected are presented in Table I for the Main Channel system and Table 2 for the Calumet area system. The station designations are in river miles measured above the Lockport Controlling Works and Locks on the Sanitary and Ship Canal.

The physical, chemical, and bacteriological analyses included in this report were carried out, unless otherwise indicated, in accordance with the procedures published in "Standard Methods for the Examination of Water and Wastewater", referred to throughout this report as "Standard Methods".

II. MAIN CHANNEL WATERWAY SYSTEMS

A. CHEMICAL AND PHYSICAL EXAMINATIONS

The following section covers the chemical and physical analyses made on samples taken at various stations on The Metropolitan Sanitary District of Greater Chicago Waterways System. The periods covered are from May 1965 to October 1965 and from June 1966 to October 1966. Sampling was carried out both by means of the District's research investigation vessel and by grab sampling from bridges.

The temperature and dissolved oxygen data are grouped according to various monthly periods, whereas the other chemical and physical analyses are grouped into the yearly periods. The determinations are presented as the algebraic means of the individual observations of each sampling station along with the minimum and maximum values observed for the given time periods.

The data from Lemont and Lockport has been averaged according to the corresponding sampling periods of the other Waterways systems and are presented in the proper figures. A more detailed presentation and discussion of the Lemont and Lockport data is given in a future section. The routine chemical and physical examination which were made and are presented in this section, included those for temperature, dissolved oxygen (DO), Biochemical oxygen demand (BOD), chemical oxygen demand (COD), pH (hydrogen ion concentration), total alkalinity, specific conductance, organic nitrogen, ammonia nitrogen (NH_3-N), nitrites and nitrates, turbidity, and suspended solids.

A number of mineral analyses were carried out on a selected number of samples during 1965. These anlyses included calcium, magnesium, potassium and sodium, In addition the same samples were analyzed for the group of heavy metals consisting of cadmium, chromium, copper, iron, lead, manganese, nickel and zinc.

Laboratory analyses in general were made in accordance to Standard Methods for the Examination of Water and Wastewater. Measurements of temperature, specific conductance, alkalinity, dissolved oxygen, ammonia, nitrite and nitrate were carried out on the District's research investigation vessel. The mineral constituents and the heavy metal analyses were by atomic absorption techniques.

The results of the analyses of samples taken at the various sampling locations are presented in Tables 3 through 5, for the North Shore Channel, North Branch of the Chicago River, Chicago River; South Branch of the Chicago River, Chicago Sanitary & Ship Canal; and the Calumet River, Cal-Sag Channel System. These tables present the minimum, maximum and mean values of the individual parameters measured at each station for the two yearly periods previously discussed. The data for the individual parameters is discussed and presented graphically in the following sections.

Temperature

The average values of water temperature taken at the time of sample collection for each of the stations during the sampling periods designated are presented in Figures 2 to 5. Due to seasonal temperature fluctuations, the data is divided into the following periods: May, June, 1965; July, August, September, 1965; October, 1965; July, August, September, 1966; and October, 1966. The mean observed temperatures for the North Shore Channel and the North Branch of the Chicago River are plotted in Figures 2 and 3, for 1965 and 1966, respectively. A rise in temperature occurs as the water flows through the Waterway System, with major increases in temperature occurring below the discharges from the North Side Treatment Plant and the Commonwealth Edison generating station at Belmont Avenue. Other temperature increases occur due to various cooling water discharges.

Overall, the temperature increases about two to three degrees in the summer between Wilmette and the junction of the South Branch of the Chicago River, and in October a three to five degree Centigrade increase was observed.

Temperature averages for the South Branch of the Chicago River and the Sanitary & Ship Canal during the 1965 and 1966 periods are presented in Figures 4 and 5. Here, we see the same general trend of increasing temperatures as we move downstream from Randolph Street (SBCR 34.45) on the South Branch of the Chicago River to Lockport (SSC 0.18) on the Sanitary & Ship Canal. Initially, there is a decrease in temperature after the North Branch of the Chicago River waters mix with the cooler Chicago River waters. Levels at Randolph varied between 21° and 23° during the summer months of 1966 and between 16° and 15° C. in October 1966. The greatest increase in temperature occurred below the Commonwealth Edison Power Plants at Throop, Crawford-Pulaski, and Ridgeland Avenues, as well as the West Southwest discharge between Central and Ridgeland Avenues. It is of interest to note that the pattern is one of a very sharp jump in temperature in the immediate vicinity of the thermal discharge, followed by the subsequent decline in water temperature to a lower level, but a level which is still higher than that previously observed above the thermal discharge. The decline in temperature is most likely due to the more complete mixing with the colder river waters and with heat dissipation to the cooler atmosphere. After a slight cooling effect, due to the input of the Cal-Sag Channel waters, there is a further rise in temperature between Lemont and Lockport. In the thirty-five (35) mile distance between Randolph Street and Lockport, an overall rise in temperature of 5^o to 6^o C was observed. Sharp monthly variations in the water temperatures are experienced corresponding to the seasonal ambient air temperatures. In general, the water temperatures during the 1966 periods were two to three degrees higher at most of the stations as compared to 1965 periods.

Dissolved Oxygen

During the warmer weather, the oxygen solubility is decreased and the rate of biochemical oxygen consumption is increased. Hence, the dissolved oxygen content in the river water is influenced by the water temperatures. The DO data was divided into the same periods as the temperature data. The average values observed for the different periods are shown in Figures 6 through 10 for the various waterway systems.

The average DO profiles for the North Shore Channel and North Branch of the Chicago River are shown in Figures 6 and 7 for the 1965 and 1966 periods respectively. The dissolved oxygen levels dropped from their high values entering at Wilmette to the lowest values at station NBCR 35.01 (Grand Avenue), just above the confluence of the North Branch of the Chicago River and the Chicago River. There are no apparent areas of dissolved oxygen recovery in this stretch of the waterways. During the summer months, when the DO level is low in the North Shore Channel immediately above the North Side Treatment Works, an initial rise in DO occurs after mixing with the North Side Treatment Works effluent. However, the oxygen increases are soon lost as the waters proceed downstream. The dissolved oxygen levels appear to start leveling off in the vicinity of mile 38 to 37, but then drop rapidly after mile 36.8. This acceleration in dissolved oxygen decline coincides with the increase in BOD and COD in this area, as presented in another section. The lowest levels of dissolved oxygen were generally observed during the warmer summer months. Between May and September 1965, the dissolved oxygen content dropped from an average of about 8 mg/l at Dempster to less than 1 mg/l in the lower region in the North Branch of the Chicago River. In October of 1965, the decrease was from 10 mg/l down to 2.5 mg/l, on an average basis.

The dissolved oxygen averages do not present a representative picture of the oxygen levels in the North Branch of the Chicago River. Although, on an average basis some dissolved oxygen was observed at all sampling stations down to the junction with the Chicago River, there were substantial numbers of days during the summer months in which zero or less than 0.5 mg/l of dissolved oxygen were observed. Based upon oxygen content, the most critical reach of this waterways system is a lower part of the North Branch of the Chicago River between North Avenue and the junction of the Chicago River. Table 6 presents the percentage of observations that dissolved oxygen content was equal to or less than a stated value at several selected stations in the lower reach of the North Branch of the Chicago River. At station NBCR 37.53 the DO content of at least fifty (50%) percent of the samples was less than 1.4 mg/l in May, June 1965, less than 1.8 mg/l in July through September, 1965, and less than 1.5 mg/l in June-September, 1966. Out of a total of 49 DO samples collected during May through September, 1965, twenty-three (23%) percent contained no dissolved oxygen. Further downstream the frequency of anaerobic conditions was even greater. At station NBCR 34.82, during May-June 1965, a zero DO level was observed in 86 percent of the samples and in 55 percent of the samples during July-September 1965. During June-September 1966, at station NBCR 35.01, 50 percent of the samples had DO of less than 0.5 mg/l.

Although there is no known major continuous pollutional discharge between Wilmette and Oakton on the North Shore Channel, the rate of oxygen depletion within this reach is quite rapid, especially during the summer months. During the period of July to September 1965, the dissolved oxygen level dropped from 8.5 mg/l at Linden Avenue to 4.5 mg/l at Oakton, for a decrease of 4 mg/l within 3.2 miles. In 1966, the observed decrease was approximately 3 mg/l within this reach.

The dissolved oxygen levels shown in Figure 7 and Figure 8 are the mean values observed for the designated periods in 1965 and 1966 on the South Branch of the Chicago River and the Sanitary & Ship Canal. A sharp rise in DO occurs after mixing of the oxygen depleted North Branch Chicago River waters and the higher oxygen containing Chicago River waters. The average DO concentrations in the Chicago River at CR 34.78 Wells Street were 5.6 mg/l during June to September 1966 and 6.2 mg/l in October 1966. At Randolph Street, mile 34.45, the sampling station immediately below the confluence of the North Branch and the Chicago Rivers, the mean DO values observed were 2.4 mg/l in May-September 1965 and 3.3 mg/l in June-September 1966. The increase in dissolved oxygen was between one to three mg/l in DO, depending upon the relative flows and DO levels in the North Branch Chicago River, and Chicago River. Downstream from this station there was a resumption in the general decrease in the dissolved oxygen to just above the West-Southwest Treatment Works at SSC 26.20, Cicero Avenue.

Immediately below the incoming discharge from the West-Southwest Treatment Works, there is a sharp rise in dissolved oxygen levels due to the addition of oxygenated effluents and the turbulence created by the discharge into the channel. The apparent benefit obtained by the addition of the oxygenated discharge is lost within about three miles below the point of discharge where the dissolved oxygen levels are approximately the same as they were above the Treatment Plant at Cicero Avenue. At Station SSC 21.98, Lawndale Avenue, the average DO levels were 1.4 mg/l in the summer of 1965 and 1.9 mg/l in October of 1965. The individual DO concentrations varied from a minimum of 0.0 mg/l to a maximum of 4.7 mg/l over the 1965 period. In the 1966 period the same approximate range was observed.

In the reach of approximately twelve (12) miles from the Chicago River to the junction with the Cal-Sag Channel, the dissolved oxygen level decreased on the average from a level of 2.5 mg/l at the upstream points to less than 0.5 mg/l at the downstream points during the summer of 1965. During the summer of 1966, the DO decreased from an average level of 3 to 1 mg/l. The October 1965 dissolved oxygen level showed a decline from a value of 4.3 mg/l at SBCR 34.45 Randolph Street down to a level of 0.6 mg/l at SSC 13.08 Highway #83. Approximately the same decrease was observed in 1966. Although the cooler periods, October 1965 and 1966, showed higher dissolved oxygen levels initially at the upstream stations, the downstream dissolved oxygen levels in the lower sections of the Sanitary & Ship Canal, below mile 18.37, are the same as the summer months, the mean values being approximately 0.5 to 1.0 mg/l. Although, on the average, the samples taken for dissolved oxygen were 1 mg/l, this does not give a true indication of the dissolved oxygen conditions occurring in this reach. Table 6 presents the frequency distribution of the observed dissolved oxygen levels during the designated periods at various sampling stations. At Station SSC 21.98, Lawndale Avenue, which is approximately 2.5 miles below the West-Southwest Treatment Works outfall, during the 1965 summer period, fifteen (15%) percent of the samples analyzed for dissolved oxygen were recorded as 0 mg/l; twenty-five (25%) percent of the samples were between 0 and 1 mg/l. At Station SSC 16.84, Willow Springs Highway, fifty-three (53%) percent of the total observed values during June through October 1966, were equal to or less than 1 mg/l, that is, fourteen (14) out of thirty-six (36) observations. The June through September period, twenty-four (24%) percent of the observations were less than 0.5 ppm; and in October 1966, forty-five (45%) percent were less than 0.5 mg/l. Therefore, it is apparent that on many days during the summer periods, this reach of six (6) miles has near anaerobic conditions occurring. Especially true, since the DO sampling was carried out at midstream, at between three (3) to five (5) feet below the surface. Thus, the dissolved oxygen levels closer to the bottom of the channel could possibly be zero on days when the levels were only a few tenths (10th) of a mg/l of DO observed close to the surface. There is strong indication that the extremely low dissolved oxygen levels are maintained in this area due to accumulation of organic bottom deposits immediately upstream of this reach. This is evident by the intensive gassification which has been observed in the summer months and at times through the cooler fall months.

After the confluence with the Cal-Sag Channel there is a slight rise in dissolved oxygen level due to the higher oxygen levels contained in the waters from the Cal-Sag Channel. From the Cal-Sag junction downstream towards

Lockport the DO profile is rather flat with a slight decrease of a few tenths of a mg/l. At Station SSC 0.18 Lockport the mean DO levels were 0.6 and 1.2 mg/l in 1965 and 0.8 and 1.5 mg/l in 1966. Since the mean DO values do not give a complete evaluation of the dissolved oxygen conditions occurring at these stations, a more detailed discussion of the extensive sampling at Lemont and Lockport is presented in a subsequent section of this report.

The dissolved oxygen profile which was observed in the Calumet River, Little Calumet River and Cal-Sag Channel system for the 1966 period is shown in Figure 10. The dissolved oxygen content declined from the upstream sampling station in the Cal-Sag Channel, CSC 27.99 Ashland Avenue, to a low point in the vicinity of CSC 23.97 Cicero Avenue, at which station the DO showed a minimum of 0.4 mg/l and a maximum of 3.6 mg/l with a mean of 1.6 mg/l. Below this station a slight recovery in DO may be observed as the waters move further downstream towards the junction with the Sanitary & Ship Canal. Table 7 presents the distribution of observed dissolved oxygen levels at CSC 13.11 Highway #83, on the Cal-Sag Channel. Whereas, the range of dissolved oxygen values during July through September 1966, was from 0.7 to 7.8 mg/l with an average of 2.8 mg/l, fifty (50%) Percent of the values were less than approximately 2.3 mg/l.

pH (Hydrogen ion concentration)

The pH results for both the 1965 and the 1966 sampling periods are shown as ranges in Figure 11. This Figure represents the range of pH values observed from Wilmette Controlling Works down through the Lockport Controlling Works for the 1965-66 period. The data show no significant difference in pH in the two-year period, and since an average pH value has no real chemical meaning, only the minimum and maximum observed values have been plotted throughout the Waterways System. In the upper reaches of the North Shore Channel, the water entering through Wilmette controlling waters varied between 8 and 8.7 pH units. The sharpest decrease in pH occurs after mixing of the North Shore Channel with the North Side Treatment Works effluent. Below the North Side Treatment Works outfall the pH varied between 6.9 and 7.5 and remained in this range down to the confluence with the Chicago River. With the input of the slightly higher pH of the Chicago River waters, there is a slight increase in pH at Randolph Street. Below this point in the rest of the waterways system down to Lockport, the pH was maintained between 7 and 8.0, the median value being 7.3.

Lower pH values in general were observed during May and June as compared to the later summer and fall months.

Total Alkalinity

The total alkalinity values plotted in Figure 12 represents a mean value of the alkalinity determinations performed on samples collected in July and August 1966. These results represent between 4 to 8 determinations made at the various sampling locations, and are expressed in terms of $CaCO_3$. The alkalinity as reported coming in through the upper part of the North Shore Channel has a mean value of 20 mg/l. Alkalinity slowly rises as the water moves downstream, and a sharp increase occurs in the vicinity of Station NBC 37.53 Ashland Avenue. At this sampling station the mean alkalinity was approximately 170 mg/l. The alkalinities range between 150 and 170 all the way down to the junction with the Chicago River. The Chicago River waters at sampling Station CR 34.78, Wells Street, exhibited a mean alkalinity of 130 mg/l. Upon mixing of the Chicago River waters and the North Branch of the Chicago River waters, the resulting alkalinity is decreased to 143 mg/l at SBCR 34.47 Randolph Street.

Below Station SBCR 34.47 the alkalinity decreased to a low mean value of 130 mg/l at SBCR 30.55 Ashland Avenue. This decline was followed by an increase to a mean of about 160 mg/l at the sampling station located below the West-Southwest Treatment Works discharge. There is a continual rise in alkalinity down toward the Cal-Sag junction. At Station SSC 15.84, Willow Springs Highway, the alkalinities reached a level of 182 mg/l.

Biochemical Oxygen Demand (BOD)

Determinations of the 5-day BOD's were carried out on samples at selected stations along the waterway system. The number of samples analyzed during the periods in 1965 and 1966 varied from six to twenty-five determinations, depending upon the sampling station. The average values of 5-day BOD observed during the 1965 and 1966 periods are presented in Figure 13. The waters entering the North Shore Channel as measured at sampling Station NSC 49.89, Linden Avenue, showed an average BOD of 2 mg/l in the summer period of 1966. An increase in the BOD level occurred as the waters flowed downstream, with values of 6.0 mg/l at NSC 47.05 Dempster in 1965 and 3.8 mg/l found at Oakton in 1966. Below the North Side Treatment Works, the BOD increased by 1 to 1.2 mg/l, to levels of 7.6 mg/l in the 1965 period and 4.9 mg/l in the 1966 period at NSC 45.06, Touhy Avenue. At this station individual values as high as 16 mg/l were found.

From Station NSC 45.06 the BOD generally decreased until the vicinity between mile 37.98 and 37.53 where the BOD increased to an average value of 8.0 mg/l (during the 1965 period) and 6.2 mg/l (in the 1966 period) respectively. The increased BOD also coincides with increased COD concentration in the area. This increase of approximately 2 mg/l indicates the addition of an organic waste which is probably the discharge from the Medill Incinerator Plant. It should be noted that construction plans have been formalized and this source of waste will soon be removed from the waterways to a sewer. The BOD then decreased downstream to averages of 5.0 mg/l at NBCR 34.82 in the 1965 period and 4.6 mg/l at NBCR 35.01 Grand Avenue in the 1966 period.

The thirteen samples collected from July through October 1966 of the Chicago River waters at CR 34.78 Wells Street had a BOD ranging from 0.9 to 7.7 mg/l with a mean of 3.1 mg/l.

Below the confluence of the North Branch Chicago River and the Chicago River, the BOD averaged 5.0 mg/l at SBCR 34.25 Madison (1965 period) and 3.6 mg/l at SBCR 34.45 Randolph (1966 period).

Chemical Oxygen Demand (COD)

The mean values of the chemical oxygen demand determinations at the various sampling locations through the waterways system, which were conducted during the 1965 and 1966 season, are presented graphically in Figure 14. During the 1966 season the average COD levels for the North Shore Channel waters above the North Side Treatment Works, ranged between 14 and 18 mg/l. In 1965 at sampling location NSC 47.05, Dempster Avenue, the COD average was 33 mg/l, with a range of 7 to 64 mg/l for seventeen (17) determinations. The COD levels increased rapidly immediately below the discharge from the North Side Treatment Works at NSC 45.06, Touhy Avenue, levels of 52 mg/l in 1965 and 36 mg/l in 1966 were observed. A single maximum value of 120 mg/l occurred in the 1965 samples. These levels represent an increase of approximately 20 mg/l on the average over the upstream sampling station. Below this location a slight decline in the COD concentration was evident followed by another sharp rise in the vicinity of mile 37.98 and mile 37.53. The mean value in the 1965 period at NBCR 37.98 was 59 mg/l and in 1966 was 45 mg/l. This coincides with the observed increase in BOD at this point. This area is also where the increase in the rate of dissolved oxygen decline occurred, as mentioned in the previous section. An individually high COD value of 99 mg/l was measured at Station NBCR 37.53, Cortland Avenue, during the 1966 season. The COD then decreased again to a level of 47 and 38 mg/l in 1965 and 1966, respectively, in the lower portion and North Branch of the Chicago River.

The Chicago River waters entering below this point had COD values ranging between 4 and 48 mg/l with a mean of 22 mg/l at sampling station CR 34.78, Wells Street. Moving down through the system to sampling location SSC 26.20, Cicero Avenue, which is just above the West-Southwest Treatment Plant Works, the COD levels were 34 and 38 mg/l in 1965 and 1966, respectively, ranging from a low of 12 mg/l up to 76 mg/l, maximum. The levels increased upon addition of the West-Southwest effluent to an average level between 43 and 45 mg/l in the reach between Harlem and Lawndale Avenues. Further on downstream, the COD results fluctuated widely, and at sampling Station SSC 16.84, Willow Springs Highway, the range of values observed was from 27 up to 45 mg/l, with a mean of 35, in the 1965 period, and in 1966 ranged from 28 to 71 mg/l with an average of 44 mg/l.

Below the Cal-Sag junction, the COD values declined with an average at SSC 9.51 Lemont from June-October 1966 of 27 mg/l. There was only a slight change in this level as the water reached Lockport where the average COD for the corresponding 1966 period was 30 mg/l. The COD determinations give no indication of any great increases in organic material between the Lemont and Lockport sampling stations. This is contrary to the observed BOD results, but as discussed in another section, the high apparent BOD values observed at Lockport are probably due to nitrification occurring in the laboratory bottles. The waters of the Cal-Sag Channel showed a mean COD in the 1966 season of 45 mg/l at CSC 13.11 Highway #83, just above the confluence with the Sanitary & Ship Canal.

Organic Nitrogen

The averages of the organic nitrogen determinations made during the periods indicated are plotted in Figure 15. The organic nitrogen levels in the upper reaches of the North Shore Channel fluctuated from individual low values of 0.1 mg/l to as high as 6.6 mg/l with mean values of 2.6 mg/l observed at NSC 47.05 Dempster in the 1965 period and of 0.8 mg/l at NSC 46.05 Oakton during the 1966 period. At Station NSC 45.06 Touhy, below the North Side Treatment Works, the averages increased to 3.2 mg/l during the 1965 period and to 2.2 mg/l during the 1966 period. From this point downstream the levels varied, but showed a general decline to 1.0 mg/l at SBCR 30.55 Ashland Avenue on the South Branch of the Chicago River. At the next downstream station SBCR 26.20 Cicero Avenue the average was 1.8 mg/l. The data for July-October 1966 showed the organic nitrogen levels remaining rather constant down through the North Branch of the Chicago River. Below the confluence with the Chicago River the values declined to 1.6 mg/l at SBCR 26.20 Cicero Avenue.

With the addition of the West-Southwest effluent the organic nitrogen increased to averages of 5.5 mg/l in 1966 period and 3.0 mg/l in the 1965 period at the downstream stations. Below this point the 1966 data showed a rapid decrease occurred to 1.1 mg/l at SBCR 16.84 Willow Springs, then increased to about 2.0 mg/l for the rest of the reach down to Lockport.

Ammonia Nitrogen

Figure 16 presents the ammonia nitrogen averages of the various waterway sampling stations during the indicated periods. The ammonia data for the 1965 period represents from 22 to 27 determinations whereas the 1966 period contains 6 to 24 determinations at the various stations. The data from both periods followed the same general pattern with the 1965 values being slightly higher in certain sections of the waterways.

Above the North Side Treatment Works in the North Shore Channel the ammonia values varied between 0.1 and 1.5 mg/l with averages of 0.4 to 0.5 mg/l. Below the North Side Treatment Works, at Station NSC 45.06, the ammonia rose to 4.3 mg/l in the 1965 period and 4.6 mg/l in the 1966 period. Values as high as 8.3 mg/l were observed at this location. Downstream from this station the levels continued to a high of 5.5 mg/l at NBCR 38.37 Fullerton Avenue.

Upon mixing with the incoming Chicago River waters the ammonia dropped sharply to an average of 3.8 mg/l at Station SBCR 34.45, Randolph Street. The Chicago River waters at CR 34.78 had ammonia averages of 2.7 mg/l in the 1965 period and 1.3 mg/l in the 1966 period. Below the confluence of the North Branch of the Chicago River and the Chicago River the ammonia concentrations continued in general to decline downstream to an average low of 3.0 mg/l at SSC 26.20 Cicero Avenue.

Downstream of the West-Southwest Treatment Works the average ammonia concentrations ranged from 7.4 mg/l to

6.3 mg/l in the 1965 period and between 5.4 mg/l and 6.6 mg/l during the 1966 period. In the Sanitary & Ship Canal from SSC 9.51 Lemont to SSC 0.18 Lockport the ammonia levels were about 4.3 mg/l during the 1966 period.

Nitrite-Nitrate

The average concentrations of nitrite-nitrate during May through October 1965 are plotted in Figure 17. The levels in the North Shore Channel above the North Side Treatment Works ranged from less than 0.2 to 0.35 mg/l. Just below the North Side Treatment Works, the average concentrations increased to 1.71 mg/l. After remaining rather constant, between 1.4 and 1.6 mg/l, the concentrations started increasing at NBCR 38.37 and continued to rise to a peak of 2.64 mg/l at NBCR 36.85, North Avenue. Thereafter, the concentrations decrease to 2.0 mg/l just above the confluence with the Chicago River.

The Chicago River waters at CR 34.78, Wells Street, contained values ranging from 0.2 to 1.8 mg/l with an average of 0.6 mg/l.

In the reach from the confluence of the Chicago River down to station SSC 26.20 on the Sanitary and Ship Canal, the levels varied between 1.0 and 1.6 mg/l. With the addition of the West-Southwest Treatment Works effluent, the nitrite-nitrate levels decreased from 1.4 mg/l to 0.9 mg/l.

Suspended Solids

The results presented in Figure 18 represent the averages of the observed values for suspended solids at the sampling stations along the Main Channel. The samples were collected during the period from May to October 1965 and the number of determinations varied between 6 to 20 depending on the sample location. The only suspended solids data available in 1966 are the determinations carried out on samples at Lemont and Lockport sampling locations on the Sanitary & Ship Canal. The suspended solids averages fluctuate between 15 mg/l and 55 mg/l throughout the waterways system. There is a general pattern of decrease concentrations in the suspended solids at those sampling stations immediately below the major treatment plant discharges. This occurred both below the North Side Treatment Works on the North Shore Channel and below the Southwest Treatment Plant on the Sanitary and Ship Canal. At NSC 46.05, Oakton Street, on the North Shore Channel, the sampling location above the Northside Treatment Plant, the suspended solids concentrations were 50 mg/l. Subsequently, after mixing with the treatment plant effluents, the suspended solids at NSC 45.06, Touhy Avenue, were found to be 30 mg/l. At Cicero Avenue, the sampling station located above the discharge from the West-Southwest Treatment Works, the suspended solids levels averaged 37 mg/l. Below the West-Southwest discharge, the suspended solids averaged 12 mg/l at Lawndale Avenue. This decrease in suspended solids below the Treatment Plant discharges is probably due to the occurrence of a natural flocculation upon mixing of the river waters and the treated effluent, and the subsequent settling of what was finer, colloidal suspended materials in the river water, as well as in the plant effluents. The suspended solids then gradually declined in the lower reach of the Sanitary & Ship Canal from a level of about 23 mg/l at Lemont to 18 mg/l at Lockport.

Turbidity

Between June and October 1965, turbidity measurements were conducted on the many samples taken in the waterways system from NSC 49.89, Linden Avenue, on the North Shore Channel down to Willow Springs Road on the Sanitary & Ship Canal. These values of the observed turbidity measurements are shown in Figure 19. The turbidity levels follow the same general pattern as that of the suspended solids. The turbidity fluctuated between 2 and 21 JC units down through the system, with definite decreases in turbidity occurring below the discharges from the major treatment plants. The North Shore Channel, upstream from the North Side Treatment Plant, had turbidity values which ranged between 14 at Linden Avenue to 21 at Oakton Street. At sampling station NSC 45.06, Touhy Avenue, below the Northside Treatment Works, the turbidity was 13. The turbidity fluctuated but, in general, declined as it moved down in the North Shore Channel and through the North Branch of the Chicago River, reaching levels of about 12 in the vicinity of NBCR 35.01, Grand Avenue, on the lower reach of the North Branch of the Chicago River. From SBCR 34.45, Randolph Street, on the South Branch of the Chicago River, just below the junction with the Chicago River, down to SSC 26.20, Cicero Avenue, the sampling location just above the West-Southwest Treatment Plant, the turbidity fluctuated between 12 and 17. At the Cicero sampling location, the average turbidity was 15. After mixing with the West-Southwest effluents, the turbidity of the water started to decline to values of 11 at SSC 22.98 down to a low of 7 at SSC 18.37, U. S. Highway #45.

Specific Conductance

The specific conductance of a water sample is related to the concentration of the dissolved ions contained within the sample. Specific conductance readings were made aboard the patrol boat as it moved through the waterways system on a given sampling date. Mean values for the May through October 1965 period and July through October 1966 period in the North Shore Channel, North Branch of the Chicago River are plotted in Figure 20. The conductivity levels followed the same general patterns during both periods with the 1966 values being slightly lower in certain areas. Conductivity of the water entering the North Shore Channel remained at a level of 270 µmhos/cm. After addition of the effluent from the North Side Treatment Works, the conductivity rose sharply to an average of 520 and 490 at NSC 45.06, Touhy Avenue, respectively. Below this station, a gradual rise occurs as dissolved solids are added to the water flowing downstream. A high of about 570 is reached at sampling location NBCR 37.98, Ashland Avenue, on the North Branch of the Chicago River. Just above the junction of the Chicago River and the North Branch of the Chicago River, the conductivity drops off to 540 in the 1965 period and 510 in the 1966 period. The conductivity at Wells Street of the Chicago River waters are in the range of 370 in 1965 and 345 in 1966.

Figure 21 presents the mean conductivity values found in the South Branch of the Chicago River and the Sanitary & Ship Canal for the two periods indicated. With the addition of dilution water from the Chicago River, the conductivity dropped to an average level of 450. Conductivity then showed a varying but steady increase to an average level of 460 in 1965 and 510 in 1966 at SSC 26.20, Cicero Avenue, A sharp rise occurred with the addition of the West-Southwest effluent, with the conductivity increasing to levels of 625 in 1965 and 595 in 1966, in the vicinity of Harlem Avenue and Lawndale Avenue. Thereafter, a gradual increase in conductivity results as the waters flow downstream reaching a level of 700 in 1965 and 650 in 1966 at SSC 0.18, Lockport sampling station during the summer months. The 1966 values are approximately 50 μmhos/cm lower in various reaches of the waterways system, as compared to the 1965 periods. The North Branch of the Chicago River at NBCR 37.55, Cortland Avenue, the conductivity range was from 380 to 655, with a mean value of 520 in 1966. However, in 1965, for the May through October period, conductivity ranged from 400 to 825 with a mean of 570. The higher conductivities were mainly observed in May 1965, ranging between 520 and 800 for a mean of about 620, which accounts partially for the higher conductivity levels observed in 1965 as compared to 1966. Similarly, high values in the lower region of the Sanitary & Ship Canal may be attributed to the high values which occurred during the May period. At the Lemont sampling station, the May mean value was 830 in 1965. The mean value from June through October 1965 would be only 710, which would compare with the 700 value observed for the July through October period in 1966.

Mineral Constituents

The mineral constituents in the water, including calcium, magnesium, potassium and sodium, were measured in a number of river samples taken from various locations along the waterways system from the North Shore Channel down through the Sanitary & Ship Canal to Cal-Sag junction. Samples were taken during the months of September and October 1965 at the upper part of the system, and between July through December, at the lower end of the Sanitary & Ship Canal. Table 8 shows the concentration of the constituents found at the various sampling locations. Calcium and magnesium constitute the quantity in water known as hardness. The average observed values are plotted in Figure 22 for the overall main channel system. At Station NSC 49.91, Isabella Avenue, on the North Shore Channel, the calcium values ranged from 36.5 to 46.3 mg/l, with the magnesium values ranging between 10.1 and 13.2 mg/l. These constituents increase to a level for calcium of 35.0 to 56.8 mg/l, and for magnesium, 12.9 to 22.4 mg/l, at the sampling station just above the junction with the Chicago River. In the fifteen-mile distance from Isabella Avenue down to the junction with the Chicago River, the calcium concentrations on the average increased by 6 ppm and the magnesium concentrations increased by 6.3 mg/l. The major percentage of this increase was due to the discharge coming into the North Side Treatment Plant at mile 44.0.

Potassium levels observed in North Shore Channel waters were in the range of 1.15 to 1.50 above the North Side Treatment Works. Immediately below the treatment plant discharges, NSC 44.06, Touhy Avenue, the average concentration increased to 4.85 mg/l and continued to increase only slightly as the water moved downstream towards the Chicago River, resulting in an average concentration of 5.42 mg/l at Kinzie Avenue. Sodium values follow the same pattern, with the mean value in the upper part of the North Shore Channel being 3.7 mg/l. The sodium concentrations increase greatly at NSC 44.06, Touhy Avenue, to a level of 27.8 mg/l, and then increase slowly to a final level of 31.7 mg/l at NBCR 34.82, Kinzie.

Table 9 presents the minimum, maximum and mean values observed at the sampling stations along the South Branch of the Chicago River and Sanitary & Ship Canal for calcium, magnesium, potassium and sodium. From the sampling station just below the junction of the North Branch of the Chicago River, SBCR 34.27, the calcium concentrations increased from a mean value of 48.1 mg/l to a mean value of 57.2 mg/l at SSC 27.27, Pulaski, Below this station down to Lockport, the average concentration varied between 50 and 56 mg/l. The magnesium values increased by about 3 mg/l from an average of 16.8 mg/l at the confluence of the Chicago River (SBCR 34.27) to 19.5 mg/l at SSC 0.18, Lockport. The concentrations of magnesium varied between 12 mg/l and 25 mg/l throughout the Sanitary & Ship Canal from Madison to Lockport. It may be noted that no appreciable rise occurred below the West-Southwest Treatment Works, indicating the same concentration levels in the plant effluent.

The concentration of potassium increased from the SBCR 34.27 mean value of 5.33 mg/l to a mean value of 6.9 mg/l at Lockport. The major portion of this increase is observed below the Southwest Treatment Works. Similarly, the sodium concentrations follow the same general pattern increasing from a mean value of 32.6 mg/l up to 44.4 mg/l downstream at the Lockport sampling station.

Heavy Metals

During 1965, in the months of September and October, samples for analyses of the heavy metals were taken from selected stations, along the North Branch of the Chicago River, the South Branch of the Chicago River, and the Sanitary & Ship Canal. At the lower end of the main channel system, sampling was conducted from July through December 1965, at stations: Willow Springs, Lemont, Lockport, on the Sanitary & Ship Canal, and Highway 83 on the Cal-Sag Channel. Heavy metals were measured in a number of samples to ascertain if any one of them might be found in significant concentration. The heavy metals which were analyzed, included chromium, manganese, nickel, copper, zinc, cadmium and lead. Those metals which were found in detectable amounts are shown in Table 10 for the North Shore Channel and North Branch of the Chicago River and in Table 11 for the South Branch Chicago River and Sanitary & Ship Canal. The tables present the number of samples in which the observed values were above the detection limits out of the total number of samples analyzed. Wherever the metals were above detectable limits, the range of values is presented. At all sampling locations the concentrations of chromium, nickel, cadmium and lead were not found to be above the detection limits of .02, .03, .01 and .10 mg/l, respectively, in all samples examined. One out of 42 samples taken from various locations on the North Shore Channel and the North Branch of the Chicago River gave values of copper above the detection limit of 0.03 mg/l. Individual high value of 0.7 mg/l was found in one instance. Only five samples out of 52 samples were found to contain any traces of copper from the lower reach of the Sanitary & Ship Canal at Lemont Road and Lockport. The values ranged from below detection limits to 0.18 mg/l. The rest of the sampling station locations on the South Branch of the Chicago River and the Sanitary & Ship Canal were below detection limits of 0.03 mg/l. Zinc was found at all stations where samples were taken. Concentrations varied from below the detection limit of 0.01 mg/l up to a maximum value of 0.18 mg/l, the maximum value being observed at SSC 27.27 on the South Branch of the Chicago River. The mean value at this station was 0.07 mg/l. Manganese was found in measureable amounts at all the sample locations, ranging from below the detection limit of 0.02 mg/l to a maximum of 0.10 mg/l. The mineral analyses which were determined on samples from the Calumet River, Little Calumet River, are presented in the section covering the Calumet area surveillance data.

B. BACTERIOLOGICAL EXAMINATION OF WATER QUALITY

The bacteriological data presented in this section was obtained from sampling at the various locations in the waterway systems during September and October 1965 and from July to October of 1966. Total coliform and fecal streptococci densities were determined on all bacteriological samples collected. Fecal coliform determinations were made on many samples taken during the 1966 periods. Presentation of the data is divided into the three major sections of the waterways system: (1) Northshore Channel, North Branch of the Chicago River, (2) South Branch of Chicago River, Chicago Sanitary and Ship Canal and (3) The Calumet River, Cal-Sag Channel. The results are expressed in terms of the geometric mean count per 100 ml as well as the minimum and the maximum values of the individual observations. The total coliform densities were determined by a membrane filter technique as described in "Standard Methods". The membrane filter technique was also used in the determination of the fecal streptococci using KF streptococci broth. Fecal coliform counts were by a membrane filter technique using MSC media as per "Standard Methods"

North Shore Channel, North Branch of the Chicago River and Chicago River Systems.

Table 12 presents a summary of the total coliform densities at the sample location along the North Shore Channel - North Branch Chicago River. The data is presented for September, October 1965 and July through October 1966. A comparison of the geometric means of the total coliform densities found in 1965 and 1966 periods are plotted in Figure 23. Figure 24 is a plot of the minimum, maximum and geometric mean total coliform values observed during the 1966 period.

In the upper reaches of the North Shore Channel, above the Northside Treatment Works, the geometric mean values increased from about 300 per 100 ml at Linden NSC 49.89 to about 6,000 per 100 ml at Oakton NSC 46.05 which is just above the Northside Treatment Works. An individual high of 90,000 per 100 ml was observed during October 1965 at Central Avenue NSC 49.23. Just below the Northside discharge at station NSC 45.06 the total coliform densities increased to about 111,000 per 100 ml in 1966 and 134,000 per 100 ml in 1965. This is an increase of approximately 20 times over the upstream sampling point. Below the Northside Treatment Works the total coliform densities generally increased moving downstream with minor fluctuations, to a high of about 920,000 per 100 ml at station NBCR 36.32 - Division Street in September, October of 1965. This was followed by a decline to a level of about 545,000 per 100 ml, just above the junction of the North Branch and the Chicago Rivers at station NBCR 34.82. During the summer period of 1966 the general increase in total coliforms in the vicinity of NBCR 37.98, Ashland Avenue to NBCR 36.32, Division Street was not observed. The range of counts increased from 110,000 per 100 ml at Touhy to about 210,000 per 100 ml at Damen. It then declined to about 90,000 per 100 ml at Grand, NBCR 35.01. Individual values as high as 7.2 and 7.4 millions per 100 ml were observed at NBCR 36.32 and NBCR 35.90 during the 1965 period. These counts were observed on days following heavy storms. For the summer period of 1966 the maximum value was 3.4 million per 100 ml detected at station NBCR 35.41 and NBCR 35.01. The intermediate high values in 1965 may be due to intermittent combined sewer discharges occurring during this period.

The results of fecal coliform examinations during the 1966 period are presented for the individual stations in Table 13. The minimum, maximum and geometric mean values are given to illustrate the variations at the individual sampling points and are plotted in Figure 25. The same general trend was observed for fecal coliform as was shown for the total coliform. At Linden Avenue, NSC 49.89 low values are observed varying between less than 10 and 300. There was an initial rise in fecal coliform density down to the Northside Treatment Plant. Below the Northside Treatment Plant the fecal coliform densities jumped up to a level of about 30,000 per 100 ml at NSC 45.06. A slight decline in densities occurs below the junction at North Branch of the Chicago River in the North Shore Channel. The levels are approximately 25,000 per 100 ml at Argyle, North Branch CR 42.26. Below this junction point the fecal coliform geometric means varied between 40,000 and 70,000 per 100 ml with a general increase at Cortland, NBCR 37.50. At the sampling station (NBCR 35.01) just above the junction of the Chicago and the North Branch Chicago Rivers the fecal coliform mean values drop to 17,000 per 100 ml.

A summary of the fecal streptococci densities found during the September, October 1965 period and during the July to October 1966 period is presented in Table 14. The geometric mean values observed during the two periods are compared in Figure 26, and Figure 27 shows the minimums, maximum, and the geometric means of the observed fecal streptococci values for 1965. Similar to the pattern of the total coliform densities we observe that the fecal streptococci averages are lower in September and October 1965 as compared to July through October 1966 in the lower reaches of the North Branch of the Chicago River. Moving downstream through the North Shore Channel the densities increased from a level of about 200 per 100 ml above the Northside Treatment Works at NSC 46.05 to a level of about 4,000 per 100 ml at the downstream station NSC 45.06 Touhy. This is a twenty fold increase in density. Between stations NSC 45.06 and NBCR 37.98 during 1965 period the level of fecal streptococci varied between 3500 and 2500 per 100 ml and then slowly decline to about 900 per 100 ml at Grand, NBCR 35.01, just above the confluence of the Chicago River. Comparison with the September, October 1966 data shows that the fecal streptococci densities continued generally to increase to a level of about 26,000 per 100 ml between mile 36.85 and 36.32 and then dropped off to 20,000 at Kinzie Avenue, NBCR 34.82.

The ratio of total coliform to fecal streptococci densities fluctuated for the individual observations. On the average, during the 1966 period, at Touhy Avenue, NSC 45.06 just below the Northside Treatment Plant the ratio was about 35 to 1 whereas, in the lower reaches of the North Branch Chicago River the ratio of total coliform to fecal streptococci is between 60 and 70 to 1.

The results of the total coliform, fecal coliform and fecal streptococcus examinations for 1966 have been plotted for the Chicago River in Figures 31, 32 and 33 respectively. In the Chicago River, just before the junction of the South Branch and the North Branch of the Chicago Rivers at CR 34.78 Wells Street, the mean total coliform densities found were 28,000 per 100 ml in 1965 and 3,300 per 100 ml in 1966. The fecal streptococci densities were 450 per 100 ml in 1965 and 135 per 100 ml in 1966. The comparison is between 7 samples taken during the months of September, October 1965 and 12 samples taken over July through October in 1966. In the 1965 period a high result of 63,000 total coliform per 100 ml accounted for the high average. If this result were omitted the geometric mean would be 8,000 per 100 ml.

South Branch of The Chicago River and Chicago Sanitary and Ship Canal

Bacterial analyses on samples from this section on the waterways were only carried out during the July to October period in 1966. Table 15 present the minimum, maximum and geometric mean values of the total coliform counts per 100 ml observed in this part of the waterway system. In the reach from the junction of the Chicago and North Branch of the Chicago Rivers down to just above the West-South West Treatment Works (Cicero Avenue, BCR 26.20) the general level total coliform densities fluctuated between 9,000 and 41,000 per 100 ml. A sharp increase in coliform densities occurs at the sampling locations below the West-Southwest Treatment Works discharge. Between station SSC 22.38 and station SSC 16.84, a distance of about 5.5 miles, the coliform counts range between 200,000 and 430,000 per 100 ml based on the geometric means. Most significant were the counts that were observed at the Harlem Avenue station SBCR 22.98 about 2.5 miles below the main discharge. At this location the coliform geometric mean was only 110,000 per 100 ml, relatively lower than the next few downstream stations. These levels increased two to threefold at the next several downstream sampling stations. Similar results were observed for fecal coliform. Below SSC 18.37, which is about 6 miles below the Southwest Treatment Works discharge the total coliform densities progressively decreased to a low geometric mean value of about 17,500 per 100 ml at SSC 5.18. The Calumet Sag-Channel comes into the Sanitary and Ship Canal at mileage point 12.48 whereupon a substantial drop in density occurs at the next downstream station, due to the lower total coliform density of the Cal-Sag waters.

The individual total coliform counts ranged from a low of less than 1,000 per 100 ml at several sampling stations to a high value of 5.7 million per 100 ml. The Harlem Avenue sampling station showed in itself great variation in total coliform counts. The range going from less than 1,000 to a maximum 5,700,000 per 100 ml with a geometric mean of 110,000 per 100 ml.

The fecal coliform densities observed during the 1966 sampling period are presented in Table 16 for the South Branch of the Chicago River and the Sanitary and Ship Canal, and are plotted in Figure 32. The fecal coliform densities follow the same trend as the total coliform densities, only with a value of 12,600 per 100 ml down to a low value of 4,500 per 100 ml at Cicero Avenue. A sharp rise was observed at the sampling stations downstream of the Southwest Treatment Works discharge. However, the maximum mean values were not obtained until between stations SSC 22,38 and SSC 18.37. At Harlem Avenue SSC 22.98 the fecal coliform densities ranged from less than 100 to a maximum of 1.2 million per 100 ml, with a geometric mean density of 26,400 per 100 ml. At Lawndale Avenue SSC 21.98, one mile below Harlem Avenue, the minimum value was 3,000 and the maximum value was 1.2 million per 100 ml, with a geometric mean of about 80,000 per 100 ml. Similar to the total coliform densities the levels which would be anticipated below a major waste treatment plant discharge which was not chlorinated, do not generally occur until one to two miles further downstream. Incomplete mixing may account for some of the discrepancies in the counts at the Harlem Avenue stations. However, the results of a limited number of cross-sectional sampling for total coliform as well as fecal coliform at this station showed no significant differences in counts from six points taken within the cross section. These limited results indicate that there is perhaps some constituent or toxic material in this immediate area which is contributing to either an inhibitory effect upon the total coliform and fecal coliform organisms or is perhaps interfering with the coliform test itself.

After mile 13.08 the fecal coliform densities gradually decreased from a geometric mean value of 90,000 per 100 ml to a geometric mean low of 2,000 per 100 ml eight miles downstream. The last sampling station SSC 5.18 Romeo Highway, however, had only 6 samples taken during the period of study. The range of counts varied from a minimum of 110 per 100 ml up to a maximum of 32,000 per 100 ml.

The fecal streptococcus results are presented in

Table 17 for those sampling stations on the South Branch of the Chicago River and the Sanitary and Ship Canal. The minimum, maximum, and geometric mean observed values have been plotted in Figure 33. In the reach from the junction with the North Branch of the Chicago River down to the sampling station just above the Southwest discharge at Cicero Avenue SSC 26.2 the fecal strep densities ranged between less than 100 per 100 ml to approximately 500 per 100 ml. A sharp rise in fecal streptococci counts occurs below the discharge of the West-Southwest Plant at SSC 22.98, Harlem Avenue. The values range between less than 10 and 120,000 per 100 ml with a geometric mean of about 13,600 per 100 ml. From this high point the densities decreased progressively as the water moved downstream reaching a low value of 137 per 100 ml at the Romeo Highway.

Calumet River, Little Calumet River and Cal-Sag Channel System

Table 18 summarized the total coliform densities observed within the Calumet River, the Little Calumet River, and the Cal-Sag Channel waterways. The samples for these analyses were taken mainly from the District boat and do not include the results of the regular Calumet Area Surveillance sampling program in the Calumet River and Little Calumet River (presented in section III). Comparison of the data showed very little difference between the bacteriological values obtained in the two different sampling programs. In order to obtain an overall indication of the bacteriological quality of these river systems, all the data gathered between July and October 1966 was used in computing the geometric means which are plotted in Figure 18. In the Calumet River the observed geometric mean total coliform densities fluctuated between 300 and 3,000 counts per 100 ml, with individual observations as high as 140,000 counts per 100 ml being noticed in certain samples. A sharp increase in total coliform counts occurred below the discharge of the Calumet Treatment Works. The sampling station immediately below this point is station LCR 21.02, Halsted Street. The mean values increased from a level of 3,200 per 100 ml upstream of the treatment plant discharge to a level of 309,000 per 100 ml downstream of the treatment plant discharge. From this point on the Little Calumet River the levels of total coliforms remained nearly constant down through the Cal-Sag Channel at a value of about 2,000,000 per 100 ml until station CSC 19.78, Southwest Expressway. Below this point as the waters move downstream the total coliform densities died off to a level of about 11,000 counts per 100 ml at station CSC 13.11, U. S. Highway 83, which is located just above the junction with the Sanitary and Ship Canal.

The fecal coliform densities observed during the period of June to October 1966 are presented in Table 19, the minimum, maximum, and geometric mean values are plotted in Figure 35. The range of values in the Calumet River start at less than 10 per 100 ml in the Harbor area and increase to about 100 to 400 per 100 ml through the Calumet River to O'Brien Locks. The fecal coliform densities increased to a level of 65,000 per 100 ml at the sampling station below the influent of the Calumet Sewage Treatment Works. From this point on down to CSC 19.87 the fecal coliform densities fluctuated between 20,000 and 60,000, then declined to a geometric mean value of 14,000 per 100 ml at CSC 13.11, U. S. Highway 83. An individually high value of 520,000 per 100 ml was observed at Cicero Avenue, CSC 23.97 on the Cal-Sag Channel.

Table 20 presents the minimum, maximum and geometric mean values for the fecal streptococcus densities that were observed in the Cal-Sag Channel and the Little Calumet River - Calumet River system. Figure 36 is a plot of the observed values. The waters entering from the

Calumet Harbor had a geometric mean fecal streptococcus density of 7 per 100 ml. Levels then increased within the Calumet River to between 200 and 300 per 100 ml. Moving downstream to the Little Calumet River there is a rise in the vicinity of the Calumet Treatment Works discharge to a geometric means value of about 1,800 per 100 ml. As the waters move down through the Cal-Sag Channel from below station CSC 27.99 the general trend of fecal streptococci was downward as the waters passed through the Cal-Sag Channel to CSC 13.11 near the confluence with the Sanitary and Ship Canal. The fecal streptococcus geometric means generally decreased from 2,000 per 100 ml at the upper end to about 30 per 100 ml at the lower end of the Cal-Sag Channel. The ratio of total coliform to fecal streptococcus densities based upon geometric means was found to be 35 to 1 at Halsted Street just below the Calumet Treatment Works and up to 350 to 1 at CSC 13.11, U. S. Highway 83, on the lower section of the Cal-Sag Channel. A more detailed discussion of the sampling stations along the Calumet River and Little Calumet River will be presented with the Calumet surveillance data.

III. SANITARY AND SHIP CANAL AT LEMONT AND LOCKPORT

Because the analytical program at these stations was carried out at much greater frequency, a more detailed review of these data is warranted.

Dissolved oxygen data for both 1965 and 1966 are presented in Tables 41 and 42 and plotted in Figures 61 to 64. The figures show only the monthly mean values, in terms of percent saturation and in mg/l. There are no significant changes between these stations. Both show extremely low values, with Lockport consistently lower than Lemont. The critical DO levels occurred between April and October. Summertime levels at Lemont averaged 1 mg/l or less between May and October, and below 5 mg/l even in the winter. At Lockport, summertime averages were 1 mg/l or less between April and October, and below 4 mg/l in winter.

The Tables present a more definitive breakdown of the oxygen data, showing the monthly frequency distribution. The Lemont data consists of four daily samples taken during the daylight hours, and the Lockport data represent the readings from a continuous DO monitor. Although there is some difference in the frequency distributions between 1965 and 1966, it is apparent from these

Tables that a DO minimum of 1.0 mg/l was achieved at Lemont, only in the five winter months in 1965 and only in three winter months in 1966. DO values below 1.0 mg/l occurred as high as 91 percent of the time in July 1965, the worst month, and 100 percent of the time in 1966. The Lockport data showed a similar pattern, except that in 1965, September appeared to have the period of lowest DO with 97 percent of the values below 1 mg/l. In 1966 the DO values were less than 0.5 mg/l 97 percent of the time.

The monthly average temperature data for these two stations are presented in Figures 65 and 66. The Lockport readings are consistently higher than Lemont. The data also show that 1966 temperatures were usually higher than 1965 temperatures at both stations by about 2° or 3° C. The month of July exhibited the highest mean temperature.

COD and BOD monthly average data are shown in Figures 67 and 68. The COD data measured only in 1966 are consistent with expected patterns, showing slight reduction in levels at Lockport over that found at Lemont. In general, the COD decrease from high values in January and February to lower levels in August and September. The BOD data with Lockport showing a BOD of about 7 mg/l higher than Lemont indicate a much different condition. This data, at first glance, would indicate that there is a very large organic load entering the canal system between Lemont and Lockport, when, in fact, no such discharge is known to occur. The logical explanation, supported by the COD data, is that the BOD rise is due to nitrification occurring at a much faster rate in the Lockport samples than in Lemont.

If the high BOD were due to an organic load from waste discharges, the COD would show a similar rise. Also, because of the large flows, this BOD difference between the two stations would represent a loading of about 130,000 pounds per day, equivalent to a P.E. of 780,000. Such a loading is not known to be present in this reach of the waterway.

The nitrogen data, Figures 69 and 70, show the total nitrogen values averaging between 7 and 9 mg/l throughout the year 1966. Approximately 70 percent of the total nitrogen is in the form of free ammonia. The unoxidized nitrogen will result in heavy oxygen demands at downstream locations due to possible conversion to nitrite and nitrate by nitrifying bacteria.

The conductivity and total dissolved solids data (Figures 71 and 72) for these stations follow similar patterns for the two years of record, with the higher dissolved solids values occurring in the colder months. Extremely high values were observed during May 1965 with a mean value of 1165. Based upon the 1965 and 1966 data, the average ratio between dissolved solids and conductivity was found to be 0.64 at Lemont and 0.73 at Lockport.

Chloride patterns (Figures 73 and 74) are similar to the conductivity and dissolved solids, as expected. The higher concentrations of chlorides occurring in the winter and early spring months must likely be a result of the heavy salting operations practiced in the Chicago area. Average chloride levels in 1966 were about 10 mg/1 higher than 1965 for each month of record.

The suspended solids levels at Lockport (Figures 75 and 76) were consistently below those found at Lemont, with minor exceptions. However, the concentrations found were high at both stations, averaging 30 mg/1 or above for most of the two years of record. At least 60 percent of the suspended solids was organic in nature.

Turbidity data (Figure 77) show a comparable pattern to suspended solids, as expected.

pH values at both stations were well within the neutral zone. No problems due to highly acid or alkaline waters were observed. A slightly higher alkalinity is evident at Lemont (Figures 78 and 79).

Streamflow measurements for both stations are presented in Figures 80 and 81. Tables 43 and 44 present the monthly average Physical and Chemical water quality data in summary form.

IV. CALUMET AREA SURVEILLANCE PROGRAM

This section presents an evaluation of the present water quality in the Calumet Area under the jurisdiction of The Metropolitan Sanitary District of Greater Chicago. This evaluation is based upon the data collected by the sampling program instituted in October of 1965. Samples were collected for chemical and physical analyses on a once-a-week basis from twelve locations on the various rivers in the Calumet Area. The identification and location of sampling stations was presented in Figure 2. In addition, data was collected during extensive studies in the summer of 1965 in the Calumet River only. A summary of this data is also presented for comparison with the Calumet Surveillance Program. The data collected between October 1965 and October 1966 has been divided into three seasonal periods which are as follows:

1. Winter period includes December 1965,

January, February and March 1966.

2. Summer period includes June, July, August and September 1966.

3. The Spring and Fall period includes October, November 1965 and April, May 1966.

The various chemical and physical analyses have been evaluated according to minimum, mean and maximum values for each of the seasonal periods. Similarly, the bacteriological data has been calculated on the basis of minimum, maximum and geometric mean values for each seasonal period.

A. CHEMICAL AND PHYSICAL EXAMINATIONS

The results of the chemical and physical analyses for each of the individual surveillance stations are summarized in Tables 31 through 32. The minimum, maximum and mean values are given for the year as well as for each of the seasonal periods previously mentioned. The analyses summarized in these tables are temperature, dissolved oxygen, BOD, COD, organic nitrogen, ammonia nitrogen, nitrite and nitrate, pH, total alkalinity, specific conductance, chloride, sulphate, phenols, hexane solubles, and total phosphates. In order to compare the changing water quality from station to station, the data has been plotted for the whole Calumet area river system on a parameter basis, and the resulting curves are shown in Figures 37 through 58. The following discussion will cover some of the individual parameters and some of the more pertinent observations with regards to them.

Temperature

The general trend of increased temperatures in the middle portion of the Calumet River is due to the numerous cooling water discharges in this area. A rise of 6° C. occurred between mile station 41.64 and mile station 39.8 with summertime temperatures reaching a mean value of 28° C. and maximum value of 35° C. Downstream of this station, temperatures tend to decline slightly to mean values of 19° C. in summer, 13° C. in spring-fall and 6° C. in winter, at CSC 27.99 Differences as high as 19° C. occurred between the summer and winter average temperatures.

Dissolved Oxygen

The dissolved oxygen levels showed seasonal differences with lower levels of DO experienced during the warmer summer months, as shown in Figure 38. The lower DO values are related to decreased solubility and increased biological activity during the warmer months. All the stations yielded some level of dissolved oxygen. However, several of the stations had observed values of less than 1 mg/l of dissolved oxygen, especially during the summer months. At Station GCR 34.83 on the Grand Calumet River, ten samples out of 46 had values of less than 1 mg/l. Five out of 49 samples taken at LCR 29.02, Halsted Street, on the Little Calumet River, were below 1 mg/l DO.

pH

The pH values for the samples collected in this area varied between 6.8 and 8.3 with only a slight decrease occurring in pH from the first station in from Lake Michigan on down to the station on the Cal-Sag Channel at Ashland Avenue.

BOD

In the Calumet River, the mean BOD ranged between less than 1 mg/l to 4 mg/l. An occasional value of 15 mg/l was observed at several of the stations on the Calumet

River. Station GCR 34.83, Torrence Avenue, on the Grand Calumet River, showed seasonal fluctuations in the BOD values with the winter BOD's ranging between 3 mg/l and 7 mg/l, with a mean of 6 mg/l. The spring and fall BOD's ranged between 4 and 36 mg/l, with a mean of 13 mg/l. CSC 27.99, Ashland Avenue on the Cal-Sag Channel, which is below the confluence of the Cal-Sag Channel and the Little Calumet River and also below the Calumet Treatment Works, had a yearly average BOD of 6 mg/l.

COD

The COD results for the various seasonal periods are shown in Figure 40. The summer values tend to be on the low side while the spring and fall values tend to be higher on the average. Based on the yearly average, the COD increased from about 12 mg/l at CR 41.64, Ewing Avenue, to about 22 mg/l at 130th Street on the Calumet River, with the addition of various industrial wastes. The sharpest increase occurred after the Calumet Treatment Works, with the COD levels going up to a yearly average of 45 mg/l. At LCR 29.18 on the Little Calumet River and GCR 34.83, Torrence Avenue on the Grand Calumet River, high COD values were found in keeping with the high BOD values.

COD values range on a yearly average of 48 mg/l at LCR 29.18 and 52 mg/l at GCR 34.83

Nitrogen

The observed seasonal averages for organic nitrogen, ammonia nitrogen and nitrite-nitrate nitrogen are shown in Figures 42, 43 and 44, respectively. The lowest values for both organic nitrogen and ammonia were observed during the summer season. Conversely, in the summer season, higher nitrite nitrate values were observed as compared to the rest of the year; thus indicating active nitrification occurring in this particular region of the waterways system. For example, at Station CR 36.01, 130th Street on the Calumet River, the total organic plus ammonia nitrogen decreased by about 2.5 mg/l from the winter to the summer period; whereas, the nitrite-nitrate nitrogen increased by 2.7 mg/l in the same period on a seasonal average basis. The individual values of organic nitrogen fluctuated widely throughout the Calumet River and the Little Calumet River System. The average organic nitrogen increased from 0.4 mg/l at CR 41.64 downstream to a value of 0.8 mg/l at CSC 27.99 at the upper end of the Cal-Sag Channel. Ammonia values at CR 41.64, Ewing Avenue, the

Calumet River Station closest to Lake Michigan, showed a yearly range of 0.1 to a maximum 2.8 mg/l with a yearly mean value of 0.5 mg/l. Then ammonia rose to about 1.8 mg/l at 106th Street and remained between 1.4 and 1.8 mg/l until LCR 29.02, Halsted Street on the Little Calumet River, which is the first station downstream of the Calumet Treatment Works. At this location, the yearly average of 7.4 mg/l represents an increase in ammonia concentration of about 5 mg/l over the upstream station. Nitrite-nitrate concentration from the spring, fall and winter season in the Calumet River lakeward of the O'Brien Locks were on the average of 0.6 to 1 mg/l. From O'Brien Locks down to CSC 27.99, Ashland Avenue, on the Cal-Sag Channel, the nitrite-nitrate levels remained fairly constant at about 1.2 to 1.3 mg/l. During the summer, as previously noted, the nitrite-nitrate levels increased rather markedly to a summer mean value of 1.6 mg/l at Ewing Avenue on the Calumet River and 4.1 mg/l at Ashland Avenue on the Cal-Sag Channel.

At Station GCR 34.83, Torrence Avenue, on the Grand Calumet River, the organic nitrogen concentration averaged 2.8 mg/l and the ammonia nitrogen averaged 4.4 mg/l.

The Little Calumet River at Station BLCR 29.18, Ashland Avenue, which is between the confluence of the

Cal-Sag Channel and the Illinois-Indiana State Line, had an average organic nitrogen concentration of 2.5 mg/l and ammonia concentration of 4.9 mg/l.

Specific Conductance

Figure 45 presents the conductivity results for the various seasons as designated. The specific conductance values did not exhibit any appreciable seasonal fluctuations. The yearly mean value increased from Lake Michigan as the water moved inland towards O'Brien Locks, due to the discharge of various industrial outfalls. At Station CR 41.64, the yearly mean was 280 micromhos/cm. This value increased to 430 micromhos/cm at Station CR 36.01, just above O'Brien Locks. Samples taken at GCR 34.83, Torrence Avenue, on the Grand Calumet River, over the yearly period range between 460 minimum and 950 maximum, with a yearly average of 710 micromhos/cm. The high conductivity values at this station are in keeping with the high values also found for other parameters at this station. The conductivity level increased sharply below the Calumet Treatment Works at Station LCR 29.02. For the winter, summer, and spring-fall periods, the averages were 720, 690, and 580 micromhos/cm, respectively.

The two stations on the Branch of the Little Calumet River, which are both above the junction with the Cal-Sag Channel but before the Indiana State Line, showed extremely high conductivity values. At BLCR 33.53, Indiana Avenue, which is closest to the Illinois-Indiana State Line, the 21 samples taken showed a range from 600 to 2100 μhos/cm. The winter and summer seasonal averages were 1,000 and 1,580, respectively.

Chlorides, Sulfates

Seasonal mean values found for chlorides and sulfates are shown in Figures 46 and 47. These two constituents follow the same general pattern as the specific conductivity measurements. At CR 41.64, Ewing Avenue, there was no seasonal difference in the chloride values. The yearly mean was 19 mg/l. Chlorides levels increased as the water flows inland toward O'Brien Locks. At 130th Street, values of 58, 48 and 55 were found for the winter, summer, spring-fall means. The chloride levels stay fairly constant until just below the Calumet Sewage Treatment Works where as LCR 29.02, Halsted Street, the concentrations nearly double. At this location, the winter period had a mean value of 108 mg/l, the summer period had a mean value of 72 mg/l and the spring-fall period showed a mean value of 78 mg/l. It should also be noted that the chloride levels were much higher during the winter period than the other two periods at this station.

The sulfate levels increase from a yearly mean value of 26 mg/l near the mouth of the Calumet River (CR 41.64) up to a mean value of 81 mg/l at CR 36.01, 130th Street, which is still lakeward of O'Brien Locks. The levels stay fairly constant down to the Calumet Treatment Works, where, similar to the chloride values, the sulfate values double. At Halsted Street, the mean values for the winter, summer, spring-fall periods were 190, 157 and 172 mg/l, respectively.

Rather high levels of chlorides and sulfates were found at GCR 34.83, Torrence Avenue, on the Grand Calumet River. The two stations on the Branch of the Little Calumet River showed extremely high chloride and sulfate values, similar to the extremely high conductivity values. At these two stations, the highest values occur during the summer months rather than the winter or spring-fall months, as was noted at several of the other sampling stations. The winter mean chloride value was 147 mg/l. The winter mean sulfate value was 193 mg/l. The summer mean value for chlorides was 256 mg/l, for sulfates, 370 mg/l. The spring and fall mean values were, for chlorides, 116 mg/l, and for sulfates, 196 mg/l.

Phenols

The average values for phenols, as shown in Figure 50, were greater during the winter months at the majority of the sampling stations. With colder temperatures and decreased biological activity, the phenols are not as readily decomposed, and thus tend to be more persistent. This assumes that the source of phenols to the waterways remains constant throughout the year. During the winter period, the fluctuation in the measured phenols levels was quite marked. The highest levels in the Calumet River occurred at Station CR 39.81, 106th Street. The mean winter value was found to be 25 micrograms / liter. The summer and spring-fall mean values were 4 micrograms / liter at this location. The level of phenolics at the upper end of the Cal-Sag Channel, CSC 27.99, showed an average of 21 micrograms / liter.

Hexane Solubles

Hexane solubles are a measure of the oil content of the water sample. The difficulty in sampling for oils is reflected in the wide scatter within the hexane soluble results. The highest values were observed during the spring-fall period, with a mean ranging between 70 mg/l and 105 mg/l. The mean during the summer period ranged between 4 and 16 mg/l at the various sampling locations. The locations which showed the highest levels were at CR 36.01, 130th Street, on the Calumet River and at BLCR 33.53, Indiana Avenue, on the Branch of the Little Calumet River below the Indiana-Illinois State Line. The mean values during the spring-fall period were 105 mg/l at 130th Street and 131 mg/l at Indiana Avenue.

Total Phosphates

The yearly mean total phosphate values in the Calumet River ranged from 0.11 mg/l at CR 41.64, Ewing Avenue, to 0.30 mg/l at CR 36.01, 130th Street, as shown in Figure 28. The Grand Calumet River at GLCR 34.83 had mean values of 4.96 mg/l in the winter, 6.48 mg/l in the summer, and 4.15 mg/l in the spring and fall. Unusually high levels of total phosphates were found in the Branch of the Little Calumet River at both sampling stations. The Indiana Avenue, mile 33.53, showed mean values for the summer, 27.18 mg/l; for the spring-fall, 10.22 mg/l; for the winter, 9.90 mg/l. Station BLCR 29.18 at Ashland Avenue on the Little Calumet River showed the highest phosphate levels occurring in the summer, with a mean of 25.40 mg/l followed by the spring-fall with a mean of 9.89 mg/l and then the winter of 5.41 mg/l. Although the flow is low in this part of the Little Calumet River, the concentrations are sufficiently high to result in an increase in total phosphates in the Cal-Sag Channel, below the confluence. Above the confluence at LCR 29.02, Halsted Street, the yearly average value was 1.67 mg/l. Below the junction of the Little Calumet River and Cal-Sag Channel at CSC 27.99, Ashland Avenue, the yearly average value was 2.79 mg/l.

Mineral Constituents

The concentrations of calcium, magnesium, potassium, and sodium found at each station during January through September 1966 are presented in Table 1. These results are presented as the minimum, maximum, and median of the observed values and are also plotted in Figures 52 to 55.

The concentrations of calcium increased, as the waters proceed inland, from a median value of 43 mg/l in the Calumet River at CR 41.64, Ewing, to a median value of 83 mg/l at CSC 27.99, Ashland, on the Cal-Sag Channel.

Exceedingly high concentrations of calcium were found on the Grand Calumet River ranging between 39 and 140 mg/l at station GCR 34.83. Similarly, the stations on the non-navigable reach of the Little Calumet River between the Illinois-Indiana State Line had high median calcium concentrations of 112 and 120 mg/l.

The magnesium levels also increased from a median of 12 mg/l near the mouth of the Calumet River (CR 41.64) to a median value of 26 mg/l at the upper end of the Cal-Sag Channel (CSC 27.99).

From station CR 41.64 on the Calumet River to station CSC 27.99 on the Cal-Sag Channel, the median levels of potassium increased from 2.6 mg/l to 8.5 mg/l.

Sodium concentrations gradually increased from a low median value of 6.8 mg/l near the mouth of the Calumet River to a median value of 7.5 mg/l at LCR 31.34 on the Little Calumet River just above the Calumet Treatment Works. At the next station (LCR 29.02) below the Calumet Treatment Works, the sodium concentrations increased to 63 mg/l. The samples taken at the two stations on the non-navigable reach of the Little Calumet River had extremely high sodium concentrations ranging between 30 and 226 mg/l with a median value of 112 mg/l.

Heavy Metals

The various heavy metals were found in general to be very low. Table 35 presents the frequency of occurrence above detectable limits and the ranges of concentrations found at the various sampling stations.

At all locations, zinc was found in measurable amounts, varying from a range of 0.03 - 0.04 mg/l at CR 41.64 on the Calumet River to the highest range of 0.01 - 2.00 mg/l at station LCR 29.02 on the Little Calumet River.

At the sampling stations on the Calumet River, concentrations of manganese varied from below the detection limit of 0.02 mg/l to a high of 1.33 mg/l. At station LCR 29.02, Halsted Street, on the Little Calumet River, the manganese levels varied from 0.08 to 14.13 mg/l.

Copper was found in measurable amounts in only two out of 148 samples from the Calumet River. All samples from the Grand Calumet River were found to be below detectable limit of 0.03 mg/l.

B. CALUMET AREA CHEMICAL QUALITY COMPARISONS (1965 - 1966)

A survey of water quality on the Calumet River was made during the period extending from June 21 to August 4,

1966. The result of the chemical analyses is presented in Table 33. A comparison of the results and levels of constituents found during the summer of 1965 period with the summer of 1966 surveillance data is made in the following section. Table 33 presents the minimum, maximum and mean values of the 13 samples which were taken during the 1965 summer period. The area under discussion extends from the Calumet Harbor inland to the Thomas J. O'Brien Locks.

Station: CR 41.64 Ewing Avenue - Calumet River

The average summer period temperatures were within the same ranges for both periods with a mean value of 22° C. The mean DO level of the 1966 samples was 5.4 mg/1 ranging between 3.8 and 7.0 mg/1. The 13 samples collected during July - August 1965 had a mean DO of 6.3. The samples varied between 5.3 and 7.4 mg/1. The COD values showed a noticeable reduction from the 1965 sampling period. The average COD value dropped from 28 mg/1 in the 1965 period to a mean of 10 mg/1 for the 16 samples in 1966. Both organic nitrogen and ammonia showed comparable levels during both study periods. Organic nitrogen found was 0.6 mg/1 in 1965 and 0.4 mg/1 in 1966. The ammonia values averaged 0.2 mg/1 in both cases. A sharp increase in nitrite-nitrate occurred during the summer of 1966 period as compared to the July 1965 period, increasing from 0.3 to 1.6 mg/l at this station. The concentration of phenol was within the same range during both periods and varied from less than 1 µg/l to 10 µg/l.

Station CR 39.81 - 106th Street - Calumet River

The dissolved oxygen averages remained the same between the two sampling periods. However, the range of the dissolved oxygen concentration was slightly greater in 1965 period varying between 5.3 to 7.4 mg/l for the 13 samples. In 1966 the range of dissolved oxygen values for 16 samples was 3.5 to 6.2 mg/l. This could possibly be due to the comparison of four months in 1966 to only one month in 1965. A sharp decrease in COD values is noticed between the two periods from 42 mg/l in 1965 to 13 mg/l in 1966. Chloride concentrations showed a slight increase from 20 to 39 mg/l. The organic nitrogen and nitrite-nitrate concentrations have both increased over the 1965 sampling period. The average value for organic nitrogen increased from 0.8 mg/l to 1.6 mg/l, in 1966. Nitrite-nitrate levels showed a substantial rise from 0.4 mg/l in the 1965 period to 2.6 mg/l in the 1966 period. The ammonia values of the 13 samples in July 1965 and the 16 samples in the summer of 1966, were substantially the same. Similarly, the phenol values ranged about the same level for both sampling periods.

Station CR 37.07 - Torrence Avenue - Calumet River

At this station the mean temperatures were slightly lower in the 1966 period as compared to the 1965 period. This was mainly due to the inclusion of September data as compared to only June to July data for 1965. The 1965 sampling period temperature ranged from 27 to 29° C. with a mean value of 28° C. During the summer period of 1966 the temperature ranged between 16 to 25° C., with a mean value of 22° C. The dissolved oxygen levels were found to be higher during the 1966 period, increasing from a mean value of 1.9 mg/l in the 1965 period to 2.4 mg/l in the 1966 period. The level of the chlorides and sulfates also were higher at this station during the 1966 period. This increase is reflected in an increase in specific conductivity from an average of 374 micromhos/cm in 1965 to an average of 410 micromhos/cm in summer 1966. Both the organic nitrogen and ammonia nitrogen levels were less in the 1966 period as compared to 1965 period. For the 13 samples taken in 1965, the organic nitrogen ranged from 0.6 to 1.6 mg/l, with an average of 1.0 mg/l. In the summer 1966 the organic nitrogen ranged from less than 1 mg/l to 4.2 with an average of 2.2 mg/l. Similarly, the ammonia nitrogen values averages 2.1 mg/l in 1965 while the average for the 16 samples of 1966 was 1.5 mg/l. The nitrite-nitrate value showed a corresponding increase between the two sampling periods. The mean values increasing from 0.5 mg/l to 2.9 mg/l. The 13 phenol samples in 1965 ranged from 0 to 22.3 µg/l with an average of 5.9 µg/l. In 1966 the mean concentration was 3 µg/l with a maximum of 11 µg/l and a minimum value of less than 1 µg/l. Decreases in phenols are possibly due to the increased temperatures during the 1966 period, resulting in a greater biodegradation of the phenols within the waterway system.

Station CR 36.01 - 130th Street - Calumet River

A slightly lower temperature was observed in the 1966 period, with the average temperature 2° C. lower than in the 1965 period. There was no appreciable difference in the average DO contents found for the two periods. The average ammonia concentrations were 2.1 mg/l for the 13 samples in July 1965 as compared to 1.5 mg/l for the 16 samples in the summer of 1966. The 16 samples in the summer 1966 period showed higher sulfate concentrations, with a mean of 82 mg/l, as compared to the July 1965 samples with a mean of 51 mg/l.

C. BACTERIOLOGICAL EXAMINATIONS - CALUMET AREA

The twelve river stations were sampled weekly for total coliform and fecal streptococcus since October 1965. However, for the purposes of evaluation only the data up to October 1966 is presented in this report. Fecal coliform densities were determined on samples collected from June 1966 through October 1966. Tables 36, 37, 38 present the maximum, minimum and geometric mean values of total coliform, fecal coliform, and fecal streptococcus observations respectively. The data has been separated into three main seasonal periods as previously discussed. In order to follow the trends which occurred in relation to the various sampling stations, the geometric mean counts of each of the bacteriological determinations were plotted on a seasonal basis. The plot of the total coliform densities are shown in Figure 9 and the fecal streptococcus densities are plotted in Figure 60. In addition to the data collected from the weekly surveillance program, a number of bacteriological samples were collected during an intensive survey conducted in the Calumet River from Lake Michigan to O'Brien Locks during the period extending from June 21 through August 4, 1965. These latter samples were analyzed for total coliform and fecal streptococcus densities, and the maximum, minimum, and mean values per 100 ml observed for these two parameters are given in Table 39. The following section is a discussion of the data collected from each of the sampling stations.

Station CR 41.64, Ewing Avenue, Calumet River

The total coliform counts made on the samples collected at this station varied from a minimum of 40 to a maximum of 44,000 per 100 ml with a geometric mean value of 633 over the total yearly period. The higher coliform densities occurred during the summer and spring-fall period. In contrast, the winter period having a geometric mean of only 162 per 100 ml as compared to 1,550 per 100 ml during the summer period. Two out of the 16 samples had extremely high values, one of 44,000 per 100 ml and the second of 34,000 per 100 ml.

The fecal coliform counts during the summer period varied from 28 per 100 ml to 44,000 per 100 ml, with a corresponding geometric mean of 371. The fecal streptococcus counts varied from 8 to 2200 per 100 ml with a geometric mean of 116 with the summer and spring-fall values being higher than the winter values.

Comparison of the total coliform counts during June-August 1965 period with those in the summer of 1966 shows higher densities during the 1966 summer period. The 13 samples collected in 1965 showed a coliform count minimum of 70 and maximum of 1400 per 100 ml with a geometric mean of 363 per 100 ml as compared to a geometric mean of 1550 per 100 ml for the summer of 1966. The fecal streptococcus densities varied between less than 10 per 100 ml and 250 per 100 ml, with a geometric mean of 88 per 100 ml. Whereas, the summer 1966 data showed a geometric mean of 155 per 100 ml. The Ewing Avenue station is situated between the mouth of the Calumet Harbor and the entrance to the Howard Slip into which the 95th Street Pumping Station discharges during periods of storm. A review of the pumping records showed that the frequency of occurrence of discharge to the Howard Slip was greater during the 1966 summer period than it was during the 1965 survey period. The two days upon which high counts were observed followed periods of storm discharge to Howard Slip.

Station CR 39.18, 106th Street, Calumet River

This station is also located on the lakeward side of the O'Brien Locks approximately 2.6 miles inland from the mouth of the Calumet River and downstream of Howard Slip the summer period showed the highest densities with total coliform counts ranging from 410 to 111,000 per 100 ml with a geometric mean of 1,390 per 100 ml. The overall geometric mean value of total coliforms for the yearly period was 143. The geometric mean values in the spring-fall period were remarkably lower at this station than at the upstream station, Ewing Avenue. This is primarily due to the absence of the individual high maximum coliform counts that were observed at Ewing Avenue.

The fecal coliform densities for the 16 samples ranged from a minimum of 70 to a maximum of 1,900 per 100 ml with a geometric mean of 267 per 100 ml. Fecal streptococcus values for the year ranged from 5 to 3,500 per 100 ml with a geometric mean of 95 per 100 ml. The summer months yielded a geometric mean of 143 per 100 ml.

Similarly to Station CR 41.64 the coliform densities observed were slightly higher during the summer 1966 sampling period as compared to the 1965 sampling period. In 1965 the 13 samples collected showed a range for total coliform of

200 to 1,000 per 100 ml with a geometric mean of 418.

CR 37.07 - Torrence Avenue, Calumet River

A slight increase occurred in the bacteriological densities observed at this point compared to the upstream stations. The total coliform count ranged from 120 up to 31,000 with a geometric mean of 1450. The 16 samples collected during the summer period of 1966 yielded fecal coliform counts from a minimum of 70 to a maximum of 3,000 per 100 ml, with a geometric mean of 450 per 100 ml. The fecal streptococcus values were also higher than the upstream stations varying between 10 and 16,000 with a geometric mean of 320. The 16 samples taken during the summer 1966 period showed higher average total coliform and fecal streptococcus as compared to the 13 samples in July 1965.

Station 36.01 - 130th Street - Calumet River

This station is located about a half mile lakeside of the O'Brien Locks. The flow at this point consists of the lake water after receiving industrial waste discharges from the various steel mills and chemical plants along the Calumet River, as well as input flow at varying times from

Lake Calumet. The total coliform values ranged from 10 to 77,000 with a geometric mean of 710. It should be noted that a single high value of 77,000 occurred during the summer period and that the second highest value was only 3200 per 100 ml of the 29 samples collected. The fecal coliform value for the summer period ranged from 20 to 1300 with a geometric mean of 216, the second highest value being only 480 per 100 ml. The fecal streptococcus values ranged from less than 5 to 1800 with a geometric mean of 81 per 100 ml. These values are slightly higher than the 13 samples which were collected in the summer of 1965. During this period the total coliform count varied between 120 and 70 with a geometric mean of 73. The fecal streptococcus count ranged from less than 10 to 800 with a geometric mean of 46; whereas, the summer data in 1966 shows a total coliform count minimum of 200 and a maximum of 76,000 to 77,000 with a geometric mean of 1200.

Station BR 34.83 - Grand Calumet at Torrence Avenue

This station is located just upstream approximately a tenth of a mile from the confluence of the Grand Calumet and Little Calumet Rivers, southeast of the O'Brien Locks Controlling Works. The total of the 46 samples collected over the yearly period at this station yielded a minimum total coliform value of 2000 and a maximum value of 9,000,000 per 100 ml. The fecal coliform values for this group are also high ranging from 500 upwards to 1.3 million with a geometric mean of 29,900. The fecal streptococcus values had a geometric mean of 1,270 and ranged from less than 5 up to 119,000. These levels show the gross arterial pollution which is coming down the Grand Calumet River.

Station BR 31.34 - Indiana Avenue - Little Calumet River

Since the Little Calumet River at this point flows southwest toward the Cal-Sag Channel, the sampling station is located upstream and northeast of the Calumet Treatment Works. The total coliform counts ranged between 900 and 1.3 million per 100 ml with a geometric mean of 16,700 per 100 ml. The maximum observed value was during the spring-fall months. The second highest value only being 160,000 per 100 ml with 50 percent of the values being less than 29,000 per 100 ml. The fecal coliform values ranged between 150 and 20,000 per 100 ml with a geometric mean of 2200 per 100 ml. These levels are slightly increased over the upstream station on the Calumet River.

Station LCR 29.02 - Halsted Street, Little Calumet River

This station is located just downstream of the Calumet Treatment Works discharge. Samples collected at this point had a total coliform count ranging from a minimum of 10,000 on upwards to a maximum of 11,000,000 per 100 ml and a geometric mean of 170,000 per 100 ml. The second highest maximum value observed was 2.2 million per 100 ml. The highest coliform densities were during the summer and spring-fall months. The geometric mean fecal coliform density was 82,500 per 100 ml. The fecal streptococci counts ranged from 100 up to 110,000 per 100 ml with a geometric mean of 4,730 per 100 ml. The bacterial quality of the water at this point reflects the unchlorinated effluent coming from the Calumet Treatment Plant.

Station CSC 27.99 - Ashland Avenue, Cal-Sag Channel

This station is located downstream on the Cal-Sag Channel below the confluence of the Little Calumet River. The 49 samples collected over the yearly period yielded total coliform counts ranging from 26,000 to 3.1 million per 100 ml, with a geometric mean of 147,000. The maximum of 3.1 million per 100 ml coincides with the high count at station LCR 29.02 of 11 million per 100 ml. Ninety-six percent of the values found were less than 2.1 million per 100 ml. The fecal coliform densities range from 10,000 to 900,000 per 100 ml, with a geometric mean of 67,100 per 100 ml. The fecal streptococci in the 48 samples taken range from less than 100 up to 110,000 with a geometric mean of 3,990 per 100 ml.

Station 29.18 - Ashland Avenue - Little Calumet River

Ashland Avenue crosses a non-navigable section of the Little Calumet River upstream of the confluence with the Cal-Sag Channel. This station should not be confused with those stations on the main stem or navigation channel of the Little Calumet River. Total coliform counts varied from 5,100 up to 900,000 per 100 ml, with the geometric mean of about 56,000 per 100 ml. The highest values were observed during the summer periods and range from 13,000 to 900,000 per 100 ml. The fecal coliform values for the 16 samples during the summer range from 2300 to 90,000 per 100 ml and a geometric mean of 10,300 per 100 ml. Minimum fecal streptococci values were less than 100 with a maximum of 110,000 per 100 ml. The fecal streptococci geometric mean values at this station were 1,330 per 100 ml. Ninety-eight percent of the values in this location had fecal streptococci densities less than 28,000 per 100 ml. The range of values for the total coliform, fecal streptococci, and fecal coliform were comparable to those found at the Indiana Avenue GCLR 33.53 station, 4.3 miles upstream from this point. Although the minimum and maximum values are slightly higher at this point as compared to the GCLR 33.53 location the geometric mean value was slightly lower.

Station BLCR 33.53, Indiana Avenue, Little Calumet River

Total coliform values range from 4700 up to 660,000 per 100 ml with a geometric mean of 22,300 per 100 ml. The fecal coliform geometric mean value was 11,800 per 100 ml with a minimum of 700 per 100 ml and the maximum of 90,000 per 100 ml during the summer months. Fecal streptococci values ranged from 50 to 90,000 per 100 ml with a geometric mean of 1600 per 100 ml. The summer period showed the lowest values with an extremely low geometric mean of only 560 at this station.

Station Wolf Lake at Spillway

This sampling station is located at the outlet from

Wolf Lake at about 126th Street just below the spillway. In general the bacteriological analyses show very low levels in most of the samples. Total coliform counts ranged between 5 and 600 per 100 ml with a geometric mean of 20 per 100 ml. The 16 samples taken during the summer months for fecal coliform gave a range of less than 5 to 209 per 100 ml with a geometric mean of 77 per 100 ml. The fecal streptococci values range from 2 to 590 per 100 ml with a geometric mean of 11 per 100 ml.

Station Carondolet Road - on Wolf Lake Ditch

This station is about 3 miles downstream from the outlet of Wolf Lake. The total coliform count value varied from 5 to 24,000 per 100 ml with a geometric mean of 199 per 100 ml. However, the maximum of 24,000 per 100 ml found during the summer months represents a single occurrence. The second highest value which was observed was 5 100 per 100 ml. The fecal coliform results varied between 30 and 1,000 per 100 ml with a geometric mean of 195 per 100 ml. The fecal streptococci varied from less than 5 to 380 per 100 ml, with a geometric mean of 82 per 100 ml. A slight increase in counts is evident when compared to the Wolf Lake outlet. This may partially be due to surface runoff entering this drainage ditch.

V. DES PLAINES RIVER WATER QUALITY AT LEMONT ROAD

Water quality in the Des Plaines River, above its junction with the Sanitary & Ship Canal, was determined at only one location, the bridge at Lemont. The data presented for both 1965 and 1966 represent samples collected four times daily during daylight hours. Some of the data, temperatures, DO, and pH are from individual determinations on each sample. Most of the data represents a daily composite of these samples. Table 46 presents a composite summary of the data collected for the Des Plaines River at Lemont.

In contrast with the Sanitary & Ship Canal, the water quality data for the Des Plaines River at Lemont should be strongly influenced by the large variations in flow, Figure 82, representing the monthly average hydrograph for this location for the two-year period indicated, shows flow extremes of 40 to 2,000 CFS, a fifty fold difference. However, a scan of the various parameters measured at the Lemont station shows little apparent correlation.

Temperature readings (Figure 83) show the typical seasonal extremes, averaging as high as 28° C. in July of 1965 and at or near $zero^{\circ}$ C. in January and February of 1966.

pH and alkalinity levels are somewhat higher than those found in the Canal but are in the expected range for natural streams of this area. (See Figure 84). The monthly mean pH values ranged from 7.6 to 8.6. The alkalinity levels showed great fluctuations, with the monthly means varying between 160 and 292 mg/l as $CaCO_3$.

The dissolved solids, conductivity and chloride data presented in Figures 85 and 86 show that these parameters are interrelated. The dissolved solids are consistently above the level of about 900 mg/l in the summer of 1966.

Turbidity and suspended solids data, Figures 87 and 88 show high values during the summer low flow periods. Suspended solids reached a high monthly mean value as high as 145 mg/l during summer months with about 60 percent being organic solids. The cause of this high turbidity is not clear from these data; however, other parameters suggest that the cause of these high turbidities is heavy summertime blooms of algae. The BOD and COD data in Figure 89 tend to support this observation.

The BOD and COD averages are consistently above 4 and 30 mg/l respectively, indicating that these waters are carrying a significant organic load. During the summer and early fall months of 1965, the levels increased to a BOD of about 10 mg/l and a COD of 50 mg/l. The large differences between the COD and BOD further indicate that the organic matter is partially stabilized suggesting that the BOD effect is due to die off of aquatic generated algae rather than unstable organic matter from sewages.

Dissolved oxygen levels are presented as averages in Figures 90 and 91 and a frequency distribution form in Table 45. The data representing monthly averages showed no levels below 4 mg/l and the frequency distribution data showed only occasional observations below 3.0 mg/l. However, since all these data represent daylight samplings, the diurnal effect is unknown. High DO variations which are possible in streams supporting heavy algae growths can easily result in DO levels near zero during the nighttime hours. Levels of DO saturation occurred during the early spring and fall months as a result of photosynthesis.

The nitrogen levels shown in Figure 92 indicate a considerable degree.

APPENDIX A

Tables 1 through 46

TABLE 1.
Sampling Stations - Locations and Designations
Major Waterways Systems

Station	Location	River System	Comments
NSC 49.89	Linden Avenue	North Shore Channel	Below Wilmette Locks
NSC 49.23	Central Avenue	North Shore Channel	
NSC 47.05	Dempster Avenue	North Shore Channel	
NSC 46.05	Oakton Street	North Shore Channel	Above Northside S.T.W.
NSC 45.55	Howard Street	North Shore Channel	Below Northside S.T.W.
NSC 45.06	Touhy Avenue	North Shore Channel	
NSC 43.03	Bryn Mawr Avenue	North Shore Channel	Above North Branch Chicago River Junction
NBCR 42.26	Argyle Street	North Branch Chicago River	Below North Branch Chicago River Junction
NBCR 41.98	Lawrence Avenue	North Branch Chicago River	Below Lawrence Avenue P.S.
NBCR 40.88	Irving Park Road	North Branch Chicago River	
NBCR 39.81	Belmont Avenue	North Branch Chicago River	
NBCR 39.45	Western Avenue	North Branch Chicago River	
NBCR 38.37	Fullerton Avenue	North Branch Chicago River	
NBCR 37.98	Ashland Avenue	North Branch Chicago River	
NBCR 37.53	Cortland Avenue	North Branch Chicago River	

TABLE 1. (continued)

Station	Location	River System	Comments
NBCR 36.85	North Avenue	North Branch Chicago River	Above North Branch Canal
NBCR 35.01	Grand Avenue	North Branch Chicago River	Below North Branch Canal
NBCR 34.82	Kinzie Avenue	North Branch Chicago River	Above Chicago River Junction
CR 34.78	Wells Avenue	Chicago River	Above North Branch Chicago River Junction
SBCR 34.45	Randolph Street	South Branch Chicago River	Below Chicago River Junction
SBCR 34.25	Madison Avenue	South Branch Chicago River	
SBCR 31.67	Halsted Street	South Branch Chicago River	Above Racine Avenue Pump Station
SSC 30.55	Ashland Avenue	Chicago Sanitary & Ship Canal	Below Racine Avenue Pump Station
SSC 28.34	Kedzie Avenue	Chicago Sanitary & Ship Canal	
SSC 27.27	Pulaski Road	Chicago Sanitary & Ship Canal	
SSC 26.20	Cicero Avenue	Chicago Sanitary & Ship Canal	
SSC 25.73	Central Avenue	Chicago Sanitary & Ship Canal	Above West Southwest S.T.W.
SSC 24.14	No. Ridgeland Lt.	Chicago Sanitary & Ship Canal	Below West Southwest S.T.W.
SSC 22.98	Harlem Avenue	Chicago Sanitary & Ship Canal	
SSC 21.98	Lawndale Avenue	Chicago Sanitary & Ship Canal	

TABLE 1.(continued)

Station	Location	River System	Comments
SSC 21.98	U.S. Highways 12-20-45	Chicago Sanitary & Ship Canal	
SSC 16.84	Willow Springs Highway	Chicago Sanitary & Ship Canal	
SSC 13.08	Highway #83	Chicago Sanitary & Ship Canal	Above Cal-Sag Channel Junction
SSC 9.51	Lemont Road	Chicago Sanitary & Ship Canal	
SSC 0.18	Lockport	Chicago Sanitary & Ship Canal	

TABLE 2.
Sampling Stations - Locations and Designations
Calumet Waterway System

Station	Location	River System	Comments
CH 42.6	Mid-Inner Harbor	Calumet Harbor	
CaR 41.64	Ewing Avenue	Calumet River	
CaR 39.81	106th Street	Calumet River	
WLS	Wolf Lake Spillway	Wolf Lake	Upper Point on Trib. to Calumet River
WLD	Carondolet Road	Wolf Lake Ditch	Lower Point on Trib. to Calumet River
CaR 36.01	130th Street	Calumet River	Above T.J.O. Lock
GCR 34.83	Torrence Avenue	Grand Calumet River	Trib. Point to Calumet R. Below T.J.O. Loc
LCR 31.34	Indiana Avenue	Little Calumet River	Above Calumet Treatment Works
LCR 29.02	Halsted Street	Little Calumet River	Below Calumet Treatment Works
BLCR 33.53	Indiana Avenue	Branch Little Calumet River	Upper Point on Trib. to Little Calumet Riv
BLCR 29.18	Ashland Avenue	Branch Little Calumet River	Lower Point on Trib. to Little Calumet Riv
CSC 27.99	Ashland Avenue	Cal-Sag Channel	Below Junction with Branch Little Cal. R.

TABLE 2. (continued)

Station	Location	River System	Comments
CSC 23.97	Cicero Avenue	Cal-Sag Channel	
CSC 16.51	104th Street	Cal-Sag Channel	
CSC 13.11	U.S. Highway #83	Cal-Sag Channel	Above Junction with S&SC

TABLE 3.
PHYSICAL AND CHEMICAL WATER QUALITY
Summary of Analyses, 1965 & 1966
North Shore Channel, North Br. Chicago R.

PARAMETER			May through Oct. 1965				July through October 1966			
			Min.	Max	Mean		Min.	Max	Mean	
		49.89	Linden Avenue							
Temp	^oC		-	-	-		18.5	25.5		
DO	mg/l		9.4	10.7			6.6	9.3		
pH			-	-	-		8.0	8.7	8.3	
Tot.Alk as $CaCO_3$			-	-	-		110	140	120	
Spec Cond.	umhos		-	-	-		220	320	270	
Chlorides	mg/l		-	-	-					
BOD	mg/l		-	-	-		2	2	2	
COD	mg/l		-	-	-		12	17	14	
Turb.	JCU		-	-	-		5	45	14	
Org-N	mg/l		-	-	-		0.1	0.7	0.4	
NH_3-N	mg/l						0.1	<1.0	-	
NO_2-NO_3	mg/l		-	-	-		-	-	-	
		49.23	Central Avenue							
Temp	^oC		10.5	20.0			16.5	25		
DO	mg/l		5.2	10.7			6.4	9.3		
pH							7.0	8.4	7.7	
Tot.Alk as $CaCO_3$			-	-	-		102	124	113	
Spec Cond.	umhos		260	270			250	280	260	
Chlorides	mg/l		-	-	-					
BOD	mg/l		-	-	-		-	-	-	
COD	mg/l		-	-	-		-	-	-	
Turb.	JCU		-	-	-		8	16	10	
Org-N	mg/l		-	-	-		-	-	-	
NH_3-N	mg/l		<0.20	0.50	0.30		-	-	-	
NO_2-NO_3	mg/l									

TABLE 3a.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER		May through October 1965			July through October 1966		
		Min.	Max	Mean	Min.	Max	Mean
47.05	Dempster Avenue						
Temp	°C	9.5	22.5		13.0	26.4	
DO	mg/l	0.0	10.5		2.0	8.2	
pH		7.0	7.8	7.4	7.4	8.1	8.0
Tot.Alk as $CaCO_3$		-	-	-	100	140	121
Spec Cond.	umhos	250	340	270	220	280	250
Chlorides	mg/l	-	-	-			
BOD	mg/l	2	22	6	-	-	-
COD	mg/l	7	64	33	-	-	-
Turb.	JCU	-	-	-	10	45	19
Org-N	mg/l	0.1	6.6	2.6	-	-	-
NH_3-N	mg/l	/0.5	1.6	0.5	-	-	-
NO_2-NO_3	mg/l	/0.2	0.30	0.26	-	-	-
46.05	Oakton Street						
Temp	°C	9.5	22.5		11.0	26.0	
DO	mg/l	0.0	9.9		2.1	7.7	
pH		7.0	7.8	7.3	7.2	8.3	8.6
Tot.Alk as $CaCO_3$		-	-	-	110	130	121
Spec Cond.	umhos	220	350	270	220	320	270
Chlorides	mg/l	-	-	-			
BOD	mg/l	-	-	-	/1	7	3.8
COD	mg/l	-	-	-	8	32	18
Turb.	JCU	-	-	-	6	43	21
Org-N	mg/l	-	-	-	0.1	1.8	0.8
NH_3-N	mg/l	/0.5	1.4	0.5	0.1	1.5	0.4
NO_2-NO_3	mg/l	0.15	0.35	0.25	-	-	-

TABLE 3b.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
	45.55	Howard Street							
Temp	^oC		12.0	24.0	-		18	26	-
DO	mg/l		-	-	-		4.5	7.0	-
pH							7.2	8.3	
Tot.Alk as $CaCO_3$			-	-	-		121	160	140
Spec Cond.	umhos		410	800	520		350	575	470
Chlorides	mg/l		-	-	-		-	-	-
BOD	mg/l		-	-	-		-	-	-
COD	mg/l		-	-	-		-	-	-
Turb.	JCU		-	-	-		10	27	15
Org-N	mg/l		-	-	-		-	-	-
NH_3-N	mg/l		-	-	-		-	-	-
NO_2-NO_3	mg/l								
	45.06	Touhy Avenue							
Temp	^oC		12.0	24.0	-		14.5	26.0	-
DO	mg/l		3.2	8.8	-		3.2	7.6	-
pH			6.9	7.4	7.2		7.2	7.5	7.3
Tot.Alk as $CaCO_3$			-	-	-		100	148	130
Spec Cond.	umhos		390	775	520		440	560	490
Chlorides	mg/l		-	-	-		-	-	-
BOD	mg/l		3	14	7		2	16	4.9
COD	mg/l		20	120	52		20	50	36
Turb.	JCU		-	-	-		7	25	13
Org-N	mg/l		-	-	-		0.8	4.8	2.2
NH_3-N	mg/l		∠0.3	8.3	4.3		1.5	5.6	4.6
NO_2-NO_3	mg/l		0.25	4.7	1.71		-	-	-

TABLE 3c.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
	43.03	Bryn Mawr Avenue							
Temp	^{o}C		12.5	24.0			17.5	26.0	
DO	mg/1		0.0	7.8			2.7	6.1	
pH			6.7	7.4			7.1	7.4	
Tot.Alk as $CaCO_3$			-	-	-		96	155	136
Spec Cond.	umhos		390	700	500		360	520	470
Chlorides	mg/1		-	-	-				
BOD	mg/1		-	-	-		-	-	-
COD	mg/1		-	-	-		-	-	-
Turb.	JCU		-	-	-		8	27	18
Org-N	mg/1								
NH_3-N	mg/1		1.8	8.6	4,3		-	-	-
NO_2-NO_3	mg/1		0.25	4.8	1.50		-	-	-
	42.26	Argyle Street							
Temp	^{o}C		-	-	-		14.0	27.0	
DO	mg/1		-	-	-		2.2	7.3	
pH			6.9	7.4			7.1	7.5	7.3
Tot.Alk as $CaCO_3$			-	-	-		136	152	142
Spec Cond.	umhos		400	790	520		360	20	480
Chlorides	mg/1		-	-	-				
BOD	mg/1		-	-	-		3	8	4.7
COD	mg/1		-	-	-		26	43	32
Turb.	JCU		-	-	-		8	28	17
Org-N	mg/1		-	-	-		-	-	-
NH_3-N	mg/1		1.5	8.9	4.3		-	-	-
NO_2-NO_3	mg/1								

TABLE 3d.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966			
			Min.	Max	Mean		Min.	Max	Mean	
41.98		Lawrence Avenue								
Temp	°C		12.5	23.5			21.0	26.0		
DO	mg/l		0.0	8.0			2.0	5.5		
pH			6.9	7.4			7.2	7.4		
Tot.Alk as $CaCO_3$			-	-	-		136	164	148	
Spec Cond.	umhos		300	775	520		470	540	500	
Chlorides	mg/l		-	-	-					
BOD	mg/l		4	18	9		-	-	-	
COD	mg/l		19	82	46		-	-		
Turb.	JCU		-	-	-		8	30	16	
Org-N	mg/l		0.9	7.8	2.0		-	-	-	
NH_3-N	mg/l						-	-	-	
NO_2-NO_3	mg/l		0.25	4.3	1.43		-	-	-	
40.88		Irving Park Road								
Temp	°C		13.0	23.0			15.0	26.0		
DO	mg/l		-	-	-		1.5	4.5		
pH			6.9	7.4	7.2		7.0	7.5	7.4	
Tot.Alk as $CaCO_3$			-	-	-		133	165	152	
Spec Cond.	umhos		370	775	540		360	540	490	
Chlorides	mg/l		-	-	-					
BOD	mg/l		-	-	-		3	6	4.2	
COD	mg/l		-	-	-		36	40	37	
Turb.	JCU		-	-	-		10	28	15	
Org-N	mg/l		-	-	-		-	-	-	
NH_3-N	mg/l		1.5	10.4	4.8		-	-	3.8	
NO_2-NO_3	mg/l		0.28	4.1	1.47		-	-	-	

TABLE 3e.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965			July through October 1966		
			Min.	Max	Mean	Min.	Max	Mean
	39.81	Belmont Avenue						
Temp	^{o}C		14.5	24.5		19.0	28.0	
DO	mg/l		0.0	7.5		1.1	4.6	
pH			6.9	7.4		7.3	7.4	
Tot.Alk as $CaCO_3$			-	-	-	140	164	154
Spec Cond.	umhos		350	800	560	480	640	566
Chlorides	mg/l		-	-	-			
BOD	mg/l		-	-	-	-	-	-
COD	mg/l		-	-	-	-	-	-
Turb.	JCU		-	-	-	11	17	12
Org-N	mg/l							
NH_3-N	mg/l		1.3	10.4	5.3	-	-	-
NO_2-NO_3	mg/l		0.25	4.5	1.42	-	-	-
	39.45	Western Avenue						
Temp	^{o}C		14.5	24.5		14.5	27.0	
DO	mg/l		-	-	-	0.9	5.7	
pH			6.9	7.4	7.2	7.0	7.5	7.3
Tot.Alk as $CaCO_3$			-	-	-	140	175	156
Spec Cond.	umhos		350	800	560	380	600	550
Chlorides	mg/l		-	-	-			
BOD	mg/l		-	-	-	3	50	3.9
COD	mg/l		-	-	-	24	43	33
Turb.	JCU		-	-	-	8	24	12
Org-N	mg/l		-	-	-	-	-	-
NH_3-N	mg/l		2.5	10.0	6.6	-	-	-
NO_2-NO_3	mg/l		0.28	4.6	1.62	-	-	-

TABLE 3f.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
	38.37	Fullerton Avenue							
Temp	°C		14.0	23.5			14.5	27.0	
DO	mg/l		0.0	6.8			0.5	4.4	
pH			6.9	7.3	7.1		7.1	7.5	7.3
Tot.Alk as $CaCO_3$			-	-	-		148	163	156
Spec Cond.	umhos		390	850	570		490	650	530
Chlorides	mg/l		-	-	-				
BOD	mg/l		-	-	-		-	-	-
COD	mg/l		-	-	-		-	-	-
Turb.	JCU		-	-	-		7	20	13
Org-N	mg/l		-	-	-		-	-	-
NH_3-N	mg/l		3.1	9.1	5.5		-	-	-
NO_2-NO_3	mg/l		0.28	6.3	2.02		-	-	-
	37.98	Ashland Avenue							
Temp	°C		14.0	23.5			20.0	27.0	
DO	mg/l		0.0	6.4			0.4	2.8	
pH			7.0	7.4	7.1		7.2	7.5	7.3
Tot.Alk as $CaCO_3$			-	-	-		145	195	167
Spec Cond.	umhos		400	850	570		400	650	570
Chlorides	mg/l		-	-	-				
BOD	mg/l		3	21	8		-	-	-
COD	mg/l		32	82	59		-	-	-
Turb.	JCU		-	-	-		10	22	14
Org-N	mg/l		0.2	6.3	1.9		-	-	-
NH_3-N	mg/l				5.4		-	-	-
NO_2-NO_3	mg/l		0.28	6.7	2.12		-	-	-

TABLE 3g.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
	37.53	Cortland Avenue							
Temp	^{o}C		13.5	24.0			15.0	27.0	
DO	mg/1						0.0	4.5	
pH			6.9	7.4	7.1		7.1	7.5	7.3
Tot.Alk as $CaCO_3$			-	-	-		162	180	168
Spec Cond.	umhos		400	825	570		380	650	520
Chlorides	mg/1		-	-	-				
BOD	mg/1		-	-	-		4	9	6.2
COD	mg/1		-	-	-		7	99	38
Turb.	JCU		-	-	-		8	25	13
Org-N	mg/1		-	-	-		1.5	4.0	2.6
NH_3-N	mg/1		2.3	8.3	5.1		3.5	5.5	4.9
NO_2-NO_3	mg/1		0.28	6.7	2.30		-	-	-
	36.85	North Avenue							
Temp	^{o}C		13.5	24.0			16.0	27.0	
DO	mg/1		0.0	6.0			0.4	5.3	
pH			6.9	7.3	7.1		7.1	7.5	7.2
Tot.Alk as $CaCO_3$			-	-	-		140	180	162
Spec Cond.	umhos		380	775	560		480	650	510
Chlorides	mg/1		-	-	-				
BOD	mg/1		-	-	-		-	-	-
COD	mg/1		-	-	-		-	-	-
Turb.	JCU		-	-	-		9	30	18
Org-N	mg/1		-	-	-		-	-	-
NH_3-N	mg/1		2.5	7.9	5.0		-	-	-
NO_2-NO_3	mg/1		0.28	6.8	2.64		-	-	-

TABLE 3h.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966			
			Min.	Max	Mean		Min.	Max	Mean	
	35.01	Grand Avenue								
Temp	°C		15.0	25.0			14.0	28.0		
DO	mg/l		-	-	-		0.0	4.1		
pH			6.9	7.3	7.1		7.1	7.3	7.2	
Tot.Alk as $CaCO_3$			-	-	-		140	160	152	
Spec Cond.	umhos		360	800	540		500	580	510	
Chlorides	mg/l		-	-	-					
BOD	mg/l		-	-	-		2.2	8.0	4.6	
COD	mg/l		-	-	-		7	99	38	
Turb.	JCU		-	-	-		8	16	12	
Org-N	mg/l		-	-	-		0.5	4.7	2.0	
NH_3-N	mg/l		1.0	8.3	4.4		2.0	9.6	5.5	
NO_2-NO_3	mg/l		/0.2	6.3	2.04		-	-	-	
	34.82	Kinzie Avenue								
Temp	°C		15.0	25.0			17.5	28.0		
DO	mg/l		0.0	4.0			0.2	2.2		
pH			6.9	7.4			7.1	7.4		
Tot.Alk as $CaCO_3$			-	-	-		120	200	159	
Spec Cond.	umhos		350	800	550		440	650		
Chlorides	mg/l		-	-	-					
BOD	mg/l		2	12	5		-	-	-	
COD	mg/l		20	69	47		-	-	-	
Turb.	JCU		-	-	-		10	27	16	
Org-N	mg/l		0.6	5.2	1.6		-	-	-	
NH_3-N	mg/l				4.8		-	-	-	
NO_2-NO_3	mg/l		/0.2	6.3	2.05		-	-	-	

TABLE 31.
PHYSICAL AND CHEMICAL WATER QUALITY
Chicago River

PARAMETER			May through October 1965				July through October 1966			
			Min.	Max	Mean		Min.	Max	Mean	
CR 34.78		Wells Street								
Temp	°C		10.0	21.0	15.5		12.5	26.0	19.0	
DO	mg/1		1.3	9.6	5.5		2.0	9.3	5.8	
pH			7.1	8.4	7.4		7.3	8.1	7.5	
Tot.Alk as $CaCO_3$			—	–	–		120	144	131	
Spec Cond.	umhos		260	540	370		270	440	344	
Chlorides	mg/1		–	–	–		–	–	–	
BOD	mg/1						0.9	7.7	3.2	
COD	mg/1						4	48	22	
Turb.	JCU		–	–	–		3	13	10	
Org-N	mg/1						0.1	5.0	1.1	
NH_3-N	mg/1		1.0	3.9	2.7		0.2	5.8	1.3	
NO_2-NO_3	mg/1		/0.2	1.80	0.6		–	–	–	
Temp	°C									
DO	mg/1									
pH										
Tot.Alk as $CaCO_3$										
Spec Cond.	umhos									
Chlorides	mg/1									
BOD	mg/1									
COD	mg/1									
Turb.	JCU									
Org-N	mg/1									
NH_3-N	mg/1									
NO_2-NO_3	mg/1									

TABLE 4.
PHYSICAL AND CHEMICAL WATER QUALITY
Summary of Analyses - 1965 & 1966
So. Br. Chicago River and Chicago Sanitary & Ship Canal

PARAMETER			May through October 1965				July through October 1966			
			Min.	Max	Mean		Min.	Max	Mean	
	34.45	Randolph Street								
Temp	°C		11.5	25.0			13.0	26.0		
DO	mg/l		0.0	7.7			0.3	7.1		
pH			6.9	7.7	7.2		7.0	7.8	7.3	
Tot.Alk as $CaCO_3$			-	-	-		140	147	143	
Spec Cond.	umhos		270	725	453		375	580	448	
Chlorides	mg/l		-	-	-					
BOD	mg/l		-	-	-		1	8	3.6	
COD	mg/l		-	-	-		8	50	30	
Turb.	JCU		-	-	-		5	28	12	
Org-N	mg/l		-	-	-		0.25	4.2	2.0	
NH_3-N	mg/l		0.5	6.6	3.8		0.4	8.2	3.5	
NO_2-NO_3	mg/l		∠0.2	5.0	1.69		-	-	-	
	34.25	Madison Street								
Temp	°C		10.5	245						
DO	mg/l		-	-	-		-	-	-	
pH			6.9	7.8	-		-	-	-	
Tot.Alk as $CaCO_3$			-	-	-		-	-	-	
Spec Cond.	umhos		320	775	453		-	-	-	
Chlorides	mg/l		-	-	-		-	-	-	
BOD	mg/l		2.0	9.9	5		-	-	-	
COD	mg/l		15	104	39		-	-	-	
Turb.	JCU		-	-	-		-	-	-	
Org-N	mg/l		0.4	5.2	2.0		-	-	-	
NH_3-N	mg/l		0.5	6.6	3.7		-	-	-	
NO_2-NO_3	mg/l									

TABLE 4a.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
	31.67	Halsted Street							
Temp	°C		11.0	25.0			14.0	29.0	
DO	mg/1		0.0	7.0			0.6	7.1	
pH			6.9	7.6			7.1	7.6	
Tot.Alk as $CaCO_3$			-	-	-		143	170	155
Spec Cond.	umhos		310	690	444		350	580	406
Chlorides	mg/1		-	-	-				
BOD	mg/1		-	-	-		-	-	-
COD	mg/1		-	-	-		-	-	-
Turb.	JCU		-	-	-		4	19	11
Org-N	mg/1		-	-	-		-	-	-
NH_3-N	mg/1		1.4	7.0	3.1		-	-	-
NO_2-NO_3	mg/1		0	4.2	1.25		-	-	-
	30.55	Ashland Avenue							
Temp	°C		13.0	26.0			15.0	31.0	
DO	mg/1		0.0	7.1			0.5	8.1	
pH			6.9	7.6	7.2		7.1	8.0	7.5
Tot.Alk as $CaCO_3$			-	-	-		120	140	131
Spec Cond.	umhos		320	660	449		230	600	386
Chlorides	mg/1		-	-	-				
BOD	mg/1		1.3	4.0	2.3		2	5.0	3.0
COD	mg/1		16	84	56		17	71	35
Turb.	JCU		-	-	-		4	25	13
Org-N	mg/1		0.3	1.9	1.0				
NH_3-N	mg/1		1.0	6.9	3.1		1.0	1.7	1.1
NO_2-NO_3	mg/1		/0.2	3.5	1.09		-	-	-

TABLE 4a.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
	31.67	Halsted Street							
Temp	°C		11.0	25.0			14.0	29.0	
DO	mg/l		0.0	7.0			0.6	7.1	
pH			6.9	7.6			7.1	7.6	
Tot.Alk as $CaCO_3$			-	-	-		143	170	155
Spec Cond.	umhos		310	690	444		350	580	406
Chlorides	mg/l		-	-	-				
BOD	mg/l		-	-	-		-	-	-
COD	mg/l		-	-	-		-	-	-
Turb.	JCU		-	-	-		4	19	11
Org-N	mg/l		-	-	-		-	-	-
NH_3-N	mg/l		1.4	7.0	3.1		-	-	-
NO_2-NO_3	mg/l		0	4.2	1.25		-	-	-
	30.55	Ashland Avenue							
Temp	°C		13.0	26.0			15.0	31.0	
DO	mg/l		0.0	7.1			0.5	8.1	
pH			6.9	7.6	7.2		7.1	8.0	7.5
Tot.Alk as $CaCO_3$			-	-	-		120	140	131
Spec Cond.	umhos		320	660	449		230	600	386
Chlorides	mg/l		-	-	-				
BOD	mg/l		1.3	4.0	2.3		2	5.0	3.0
COD	mg/l		16	84	56		17	71	35
Turb.	JCU		-	-	-		4	25	13
Org-N	mg/l		0.3	1.9	1.0				
NH_3-N	mg/l		1.0	6.9	3.1		1.0	1.7	1.1
NO_2-NO_3	mg/l		≤0.2	3.5	1.09		-	-	-

TABLE 4b.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966			
			Min.	Max	Mean		Min.	Max	Mean	
	28.34	Kedzie Avenue								
Temp	°C		12.5	27.0			17.0	28.0		
DO	mg/l		-	-	-		0.0	6.5		
pH			7.0	7.5			7.0	7.9		
Tot.Alk as $CaCO_3$			-	-	-		145	156	153	
Spec Cond.	umhos		280	700	453		240	500		
Chlorides	mg/l		-	-	-					
BOD	mg/l		-	-	-		-	-	-	
COD	mg/l		-	-	-		-	-	-	
Turb.	JCU		-	-	-		4	12	10	
Org-N	mg/l		-	-	-		-	-	-	
NH_3-N	mg/l		1.5	5.9	3.0		-	-	-	
NO_2-NO_3	mg/l		/0.2	5.0	1.13		-	-	-	
Temp	°C									
DO	mg/l									
pH										
Tot.Alk as $CaCO_3$										
Spec Cond.	umhos									
Chlorides	mg/l									
BOD	mg/l									
COD	mg/l									
Turb.	JCU									
Org-N	mg/l									
NH_3-N	mg/l									
NO_2-NO_3	mg/l									

TABLE 4o.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
	27.27	Pulaski Road							
Temp	°C		18.5	34.5			22.0	36.0	
DO	mg/1		0.0	6.6			0.2	6.4	
pH			7.0	7.6	7.3		7.2	7.8	7.3
Tot.Alk as $CaCO_3$			-	-	-		150	166	157
Spec Cond.	umhos		330	725	455		260	560	433
Chlorides	mg/1		-	-	-				
BOD	mg/1		-	-	-		-	-	-
COD	mg/1		-	-	-		-	-	-
Turb.	JCU		-	-	-		5	34	17
Org-N	mg/1		-	-	-		-	-	-
NH_3-N	mg/1		0.9	4.7	3.0		-	-	-
NO_2-NO_3	mg/1		/0.1	4.6	1.28		-	-	-
	26.20	Cicero Avenue							
Temp	°C		16.0	25.5			18.5	37.0	
DO	mg/1		-	-	-		0.2	6.1	
pH			7.0	7.5	7.3		7.1	7.9	7.4
Tot.Alk as $CaCO_3$			-	-	-		100	160	145
Spec Cond.	umhos		310	725	462		440	625	511
Chlorides	mg/1		-	-	-				
BOD	mg/1		0.5	8.5	3.4		2	14	5.0
COD	mg/1		16	76	34		12	64	38
Turb.	JCU		-	-	-		5	27	15
Org-N	mg/1		0.4	3.8	1.8		0.2	3.4	1.6
NH_3-N	mg/1		2.3	4.4	2.9		0.3	9.5	3.0
NO_2-NO_3	mg/1		/0.1	4.3	1.38		-	-	-

TABLE 4d.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966			
			Min.	Max	Mean		Min.	Max	Mean	
	25.73	Central Avenue M.S.D.								
Temp	°C		15.0	28.5			20.0	36.0		
DO	mg/l		0.0	5.4			0.6	4.9		
pH			7.0	7.7			7.0	7.4		
Tot.Alk as $CaCO_3$			-	-	-		140	160	149	
Spec Cond.	umhos		310	725	461		440	625	518	
Chlorides	mg/l		-	-	-					
BOD	mg/l		-	-	-		-	-	-	
COD	mg/l		-	-	-		-	-	-	
Turb.	JCU		-	-	-		9	18	14	
Org-N	mg/l		-	-	-		-	-	-	
NH_3-N	mg/l		1.9	6.2	3.1		-	-	-	
NO_2-NO_3	mg/l		0	4.3	1.39		-	-	-	
	24.14	N. Ridgeland Light								
Temp	°C		19.5	29.0			22.0	35.0		
DO	mg/l		0.0	5.5			2.0	5.1		
pH			7.0	7.5			7.0	7.8		
Tot.Alk as $CaCO_3$			-	-	-		160	180	165	
Spec Cond.	umhos		440	800	627		370	720	552	
Chlorides	mg/l									
BOD	mg/l		-	-	-		-	-	-	
COD	mg/l		-	-	-		-	-	-	
Turb.	JCU		-	-	-		-	-	-	
Org-N	mg/l		-	-	-		-	-	-	
NH_3-N	mg/l		2.9	8.8	6.5		-	-	-	
NO_2-NO_3	mg/l		$\underline{/}$0.1	2.9	0.96		-	-	-	

TABLE 4e.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
	22.98	Harlem Avenue							
Temp	°C		19.5	29.5			19.0	35.0	
DO	mg/l		0.8	5.1			0.2	6.4	
pH			7.1	7.5	7.3		7.2	7.8	7.3
Tot.Alk as $CaCO_3$			-	-	-		154	160	158
Spec Cond.	umhos		450	800	615		340	710	598
Chlorides	mg/l		-	-	-				
BOD	mg/l		-	-	-		2.6	17	6.1
COD	mg/l		-	-	-		21	66	43
Turb.	JCU		-	-	-		5	14	11
Org-N	mg/l		-	-	-		0.5	3.2	5.5
NH_3-N	mg/l		2.9	9.4	7.0		2.0	9.7	5.4
NO_2-NO3	mg/l		/0.1	2.9	0.90		-	-	-
	21.98	Lawndale Avenue							
Temp	°C		20.5	28.5			22.0	34.0	
DO	mg/l		0.0	4.7			0.7	4.7	
pH			7.1	7.5			7.3	8.0	7.4
Tot.Alk as $CaCO_3$			-	-	-		160	170	163
Spec Cond.	umhos		450	825	635		460	710	590
Chlorides	mg/l		-	-	-				
BOD	mg/l		3.5	10	6.0		-	-	-
COD	mg/l		28	80	45		-	-	-
Turb.	JCU		-	-	-		4	18	9
Org-N	mg/l		0.6	4.7	3.0		-	-	-
NH_3-N	mg/l		3.1	11.3	7.4		-	-	
NO_2-NO3	mg/l		/0.1	2.8	0.84		-	-	-

TABLE 4f.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			May through October 1965				July through October 1966			
			Min.	Max	Mean		Min.	Max	Mean	
	18.37	U.S. Hwys. #12,20, &45								
Temp	°C		-	-	-		18.0	33.0		
DO	mg/1		-	-	-		0.0	4.4		
pH							7.1	7.3		
Tot.Alk as $CaCO_3$			-	-	-		170	186	180	
Spec Cond.	umhos		520	875			600	890	617	
Chlorides	mg/1		-	-	-					
BOD	mg/1		-	-	-		4	7	5.2	
COD	mg/1		-	-	-		23	47	45	
Turb.	JCU		-	-	-		3	14	7	
Org-N	mg/1		-	-	-		-	-	-	
NH_3-N	mg/1		-	-	-		5.5	8.0	6.3	
NO_2-NO_3	mg/1									
	16.84	Willow Springs Hwy.								
Temp	°C		19.5	27.5			18.0	33.0		
DO	mg/1		0.0	2.3			0.2	4.3		
pH			7.0	7.5	-		7.2	7.8	7.3	
Tot.Alk as $CaCO_3$			-	-	-		174	190	182	
Spec Cond.	umhos		480	875	668		360	750	-	
Chlorides	mg/1		-	-	-					
BOD	mg/1		5.2	15.5	7.1		3	9	5.2	
COD	mg/1		27	45	35		28	71	44	
Turb.	JCU		-	-	-		-	-	-	
Org-N	mg/1		1.2	5.6	3.2		0.7	3.2	1.1	
NH_3-N	mg/1		3.8	7.5	6.3		4.5	10.3	6.6	
NO_2-NO_3	mg/1									

TABLE 4g.
PHYSICAL AND CHEMICAL WATER QUALITY

PARAMETER			1965				1966			
			Min.	Max	Mean		Min.	Max	Mean	
	13.08	Hwy. #83								
Temp	°C		19.0	27.5			18.0	34.0		
DO	mg/1		0.0	1.4			0.0	3.7		
pH			7.0	7.5			7.1	7.5	7.2	
Tot:Alk as CaCO$_3$			-	-	-		150	200	176	
Spec Cond.	umhos		450	900	648		570	725	-	
Chlorides	mg/1		-	-	-					
BOD	mg/1		2.7	10	5.3		-	-	-	
COD	mg/1		31	53	42		-	-	-	
Turb.	JCU		-	-	-		-	-	-	
Org-N	mg/1		2.2	4.2	3.1		-	-		
NH$_3$-N	mg/1		3.1	12.1	7.1		-	-	-	
NO$_2$-NO$_3$	mg/1									
Temp	°C									
DO	mg/1									
pH										
Tot.Alk as CaCO$_3$										
Spec Cond.	umhos									
Chlorides	mg/1									
BOD	mg/1									
COD	mg/1									
Turb.	JCU									
Org-N	mg/1									
NH$_3$-N	mg/1									
NO$_2$-NO$_3$	mg/1									

TABLE 8.
PHYSICAL AND CHEMICAL WATER QUALITY

Summary of Analyses
Cal-Sag Channel

PARAMETER			1965				July through October 1966		
			Min.	Max	Mean		Min.	Max	Mean
13.11	Hwv. #83 (Sag)								
Temp	°C						13.0	28.0	19.3
DO	mg/1						0.8	7.8	2.8
pH									
Tot.Alk as $CaCO_3$							160	186	175
Spec Cond.	umhos						7.0	7.6	
Chlorides	mg/1						-	-	-
BOD	mg/1						1	9	4.2
COD	mg/1						31	85	46
Turb.	JCU						-	-	-
Org-N	mg/1						0.5	4.5	2.2
NH_3-N	mg/1						2.3	8.0	5.7
NO_2-NO_3	mg/1						-	-	-
23.97	Hwy. #50 (Cicero)								
Temp	°C						14.0	28.0	20.3
DO	mg/1						0.4	4.5	2.7
pH							7.1	7.6	
Tot.Alk as $CaCO_3$							-	-	-
Spec Cond.	umhos								
Chlorides	mg/1						-	-	-
BOD	mg/1						3	9	6.0
COD	mg/1						24	50	36
Turb.	JCU						-	-	-
Org-N	mg/1						1.5	3.6	2.3
NH_3-N	mg/1						3.5	8.8	6.4
NO_2-NO_3	mg/1								

TABLE 6.
Frequency Distribution of Observed
Dissolved Oxygen Levels
North Shore Channel & North Branch of Chicago R.

STATIONS		PERCENTAGE OF OBSERVED VALUES EQUAL TO OR LESS THAN STATED VALUE															No. of Obs.
		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	
Cortland Avenue **NBCR 37.53**																	
May - June	1965	25	29	39	54	64	79	79	86	89	93	93	93	100			28
July - Sept.	1965	19	19	29	33	57	91	95	100								21
Oct.	1965			9	18	18	18	27	36	54	100						11
June - Sept.	1966	5	15	25	50	65	75	90	95	100							20
Oct.	1966					17	33	50	67	100							6
Grand Avenue **NBCR 35.01**																	
June - Sept.	1966	14	50	82	96	100											22
Oct.	1966		20	20	40	50	50	60	90								10
Kinzie Avenue **NBCR 34.82**																	
May - June	1965	86	89	89	89	89	93	97	97	100							28
July - Sept.	1965	55	55	59	77	86	91	100									22
Oct.	1965	18	18	27	27	27	36	36	72	100							11

TABLE 7.
Frequency Distribution of Observed Dissolved Oxygen Levels Sanitary & Ship Canal and Cal-Sag Channel

STATIONS	PERCENTAGE OF OBSERVED VALUES EQUAL TO OR LESS THAN STATED VALUE															No. of Obs.
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	
Lawndale Avenue SSC 21.98 Sanitary & Ship Canal																
May - June 1965	5	5	11	28	67	78	83	95	100							18
July - Sept. 1965	15	15	40	60	80	90	95	95	95	100						20
Oct. 1965	20	20	20	40	40	40	80	80	80	80	100					5
June - Sept. 1966			9	27	45	45	54	73	73	82	100					11
Oct. 1966					20	40	40	60	60	100						5
Willow Springs Hwy. SSC 16.84 Sanitary & Ship Canal																
June - Sept. 1966	4	24	52	56	56	68	84	84	92	100						25
Oct. 1966		45	54	64	82	91	91	100								11
Highway #83 CSC 13.11 Cal-Sag Channel																
June - Sept. 1966			9	26	43	57	65	70	83	91	91	96	96	96	96	23

Table 8.
Summary of Mineral Constituent Levels (1)
North Shore Channel & North Branch of Chicago R.
September through October, 1965

Station Location		Calcium (Ca^{++})	Magnesium (Mg^{++})	Potassium (K^{+})	Sodium (Na^{+})
NSC 49.91 Isabella	Min.	36.5	10.1	1.15	3.5
	Max.	46.3	13.2	1.15	3.8
	Mean	42.2	11.4	1.15	3.6
NSC 49.23 Central	Min.	41.8	13.0	1.15	3.3
	Max.	44.8	14.2	1.25	3.8
	Mean	42.8	13.7	1.22	3.6
NSC 47.05 Dempster	Min.	38.8	10.8	1.20	3.3
	Max.	43.8	13.9	1.50	4.0
	Mean	41.0	12.8	1.34	3.8
NSC 45.06 Touhy Avenue	Min.	41.8	14.1	3.40	18.4
	Max.	47.5	17.2	5.80	38.1
	Mean	46.1	16.0	4.85	27.8
NBCR 41.98 Lawrence	Min.	42.8	15.2	3.20	17.2
	Max.	55.0	17.4	5.70	32.1
	Mean	47.4	16.0	4.61	26.0
NBCR 37.98 North Ashland	Min.	40.5	14.0	4.40	22.8
	Max.	52.5	20.0	7.70	45.4
	Mean	48.0	17.2	5.50	33.1
NBCR 34.82 Kinzie	Min.	35.0	12.9	4.20	21.6
	Max.	56.8	22.4	7.60	46.4
	Mean	48.2	17.7	5.42	31.7

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(1) Analyses by Atomic Adsorption Spectrophotometer Technique expressed as mg/l.

TABLE 9.
Summary of Mineral Constituent Levels (1)
So. Br. Chic. R. & San & Ship Canal
September & October 1965

STATION LOCATION		Calcium (Ca++)	Magnesium (Mg++)	Potassium (K +)	Sodium (Na +)
SBCR 34.27 Madison	Min	35.8	11.9	5.15	31.0
	Max	61.2	22.9	5.60	33.7
	Mean	48.1	16.8	5.33	32.6
SBCR 33.23 Roosevelt	Min	38.8	12.9	3.50	19.1
	Max	59.0	22.9	6.00	40.0
	Mean	49.2	17.8	4.98	29.5
SBCR 31.67 Halsted	Min	32.5	12.1	3.35	17.0
	Max	61.3	23.4	6.15	39.4
	Mean	47.6	17.2	4.44	27.1
S & SC 30.55 S. Ashland	Min	32.5	12.1	2.85	15.6
	Max	59.0	22.4	5.70	37.6
	Mean	49.0	17.4	4.76	29.2
S & SC 27.27 Pulaski	Min	43.0	13.5	4.40	21.6
	Max	73.8	24.5	6.15	40.0
	Mean	57.2	19.2	5.38	31.8
S & SC 24.14 Ridgeland	Min	50.0	17.1	6.10	35.2
	Max	61.3	23.2	8.65	66.4
	Mean	56.3	20.6	7.48	46.8
S & SC 21.98 Lawndale	Min	44.5	16.9	6.55	37.4
	Max	62.0	22.4	9.30	73.0
	Mean	53.4	20.3	7.41	48.2
S & SC 14.75 Nav. Light 305.7	Min	36.8	13.4	5.00	30.3
	Max	61.3	22.4	7.40	44.5
	Mean	50.0	18.3	6.18	37.4

TABLE 9. (continued)

STATION LOCATION		Calcium (Ca++)	Magnesium (Mg++)	Potassium (K +)	Sodium (Na +)
S & SC 11.94 Nov. Light 302.9	Min	40.8	15.3	5.25	27.7
	Max	67.8	23.4	7.60	46.9
	Mean	54.2	19.2	6.31	37.0
S & SC 9.51 Lemont Rd	Min	44.5	14.4	6.1	40.0
	Max	71.5	24.5	8.9	53.3
	Mean	55.5	19.8	7.2	43.4
S & SC 0.18 Lockport	Min	46.8	17.7	5.5	30.0
	Max	59.3	21.8	8.1	53.0
	Mean	54.3	19.5	6.9	44.4

(1) **Analyses by Atomic Adsorption Spectrophotometer Technique expressed as mg/l.**

TABLE 10.
Summary of Heavy Metals Analyses
North Shore Channel and North Br. Chicago R.
Sept. & Oct., 1965

	Mn	Cu	Zn
Detection Limit (dl) - mg/l	0.02	0.03	0.01
Station: NSC 47.05 Dempster			
No. of obs. above dl	3	1	4
No. of samples	11	11	11
Range - mg/l	bdl-0.06	bdl-0.08	bdl-0.10
Station: NSC 45.06 Touhy			
No. of obs. above dl	4	1	6
No. of samples	8	8	8
Range	bdl-0.06	bdl-0.06	bdl-0.12
Station: NBCR 41.98 Lawrence			
No. of obs. above dl	3	1	7
No. of samples	8	8	8
Range	bdl-0.09	bdl-0.70	bdl-0.10
Station: NBCR 37.98 Ashland Avenue			
No. of obs. above dl	2	1	5
No. of samples	7	7	7
Range	bdl-0.06	bdl-0.07	bdl-0.10
Station: NBCR 34.82 Kinzie Avenue			
No. of obs. above dl	4	0	6
No. of samples	8	8	8
Range	bdl-0.06	bdl	bdl-0.10

NOTE: Other heavy metals were below detection limits on all samples analyzed: Cr (0.02), Ni (0.03), Cd (0.01) and Pb (0.10).

TABLE 11.
Summary of Heavy Metals Analyses
So. Br. Chicago R., and Sanitary & Ship Canal
Sept. & Oct., 1965

	Mn	Cu	Zn
Detection Limit (dl) - mg/l	0.02	0.03	0.01
Station: SBCR 34.27 Madison Street			
No. of obs. above dl	3	0	4
No. of samples	11	11	11
Range - mg/l	bdl-0.09	bdl	bdl-0.10
Station: SBCR 31.67 Halsted			
No. of obs. above dl	3	0	3
No. of samples	4	4	4
Range	bdl-0.09	bdl-bdl	bdl-0.08
Station: SBCR 30.55 Ashland Avenue			
No. of obs. above dl	5	0	7
No. of samples	10	10	10
Range	bdl-0.10	bdl-bdl	bdl-0.09
Station: SSC 27.27 Pulaski Road			
No. of obs. above dl	2	0	4
No. of samples	4	4	4
Range	bdl-0.10	bdl-bdl	0.08-0.18
Station: SSC 24.14 N. Ridgeland			
No. of obs. above dl	3	0	4
No. of samples	4	4	4
Range	bdl-0.09	bdl-bdl	0.10-0.12
Station: SSC 21.98 Lawndale			
No. of obs. above dl	3	0	4
No. of samples	4	4	4
Range	bdl-0.09	bdl-bdl	0.06-0.14
Station: SSC 14.75 W.S.L.L. #305.7			
No. of obs. above dl	3	0	2
No. of samples	4	4	4
Range	bdl-0.10	bdl-bdl	bdl-0.11
Station: SSC 11.94 Lemont Lt. #302.9			
No. of obs. above dl	3	0	4
No. of samples	4	4	4
Range	bdl-0.10	bdl-bdl	0.05-0.09
Station: SSC 9.51 Lemont Rd.(2)			
No. of obs. above dl	18	2	18
No. of samples	26	26	26
Range	bdl-0.15	bdl-0.07	bdl-0.20
Station: SSC 0.18 Lockport(2)			
No. of obs above dl	17	3	19
No. of samples	26	26	26
Range	bdl-1.70	bdl-0.18	bdl-0.32

(1) NOTE: Other heavy metals were bdl on all samples analyzed: Cr (0.02), Ni (0.03 Cd (0.01) and Pb (0.10).

(2) Data covers from July through December, 1965.

Table 12.
Summary of Total Coliform Densities
(Counts / 100 ml.)
North Shore Channel, North Branch Chicago R. and Chicago R.

Sampling Location	September - October, 1965				July - October, 1966			
	No. of Obs.	Minimum	Maximum	Geo. Mean	No. of Obs.	Minimum	Maximum	Geo. Mean
NSC 49.89 Linden	5	70	1,000	310	5	/100	1,000	289
49.23 Central	11	50	90,000	8,740	-	-	-	-
48.70 Green Bay	3	120	200	167	-	-	-	-
47.85 Emerson	4	/100	2,000	875	-	-	-	-
Church	3	100	800	630	-	-	-	-
47.05 Dempster	11	500	51,000	8,430	8	500	53,000	4,995
46.05 Oakton	11	300	76,000	14,980	11	300	60,000	5,934
45.06 Touhy	11	2,900	350,000	133,900	13	40,000	400,000	110,800
44.04 Devon	-	-	-	-	7	90,000	300,000	151,200
43.03 Bryn Mawr	11	70,000	1,500,000	307,300	-	-	-	-
NBC 42.26 Argyle	8	80,000	1,300,000	467,100	12	80,000	520,000	168,300
NBC 41.98 Lawrence	11	80,000	1,200,000	283,600	-	-	-	-
40.35 Addison	11	90,000	1,100,000	310,900	-	-	-	-
39.45 Western	-	-	-	-	15	40,000	740,000	209,900
38.69 Damen	11	80,000	3,600,000	542,700	-	-	-	-
38.37 Fullerton	-	-	-	-	13	27,000	800,000	170,700
37.98 Ashland	8	60,000	2,500,000	618,700	-	-	-	-
37.53 Cortland	-	-	-	-	8	25,000	800,000	127,700
36.85 North	11	70,000	5,500,000	780,900	10	21,000	2,300,000	109,000
36.32 Division	10	80,000	7,200,000	919,000	-	-	-	-
35.90 Ogden	10	60,000	7,400,000	913,000	-	-	-	-
35.41 Chicago	11	60,000	3,900,000	746,900	5	60,000	3,400,000	155,700
Ontario	6	80,000	2,400,000	523,000	-	-	-	-
35.01 Grand	-	-	-	-	14	19,000	3,400,000	87,620
NBC 34.82 Kinzie	11	40,000	2,700,000	544,500	-	-	-	-
Chicago River								
CR 34.78 Wells	7	1,000	63,000	28,400	12	/100	100,000	3,267
34.86 LaSalle					4	/1,000	130,000	5,328
35.32 Michigan					4	1,000	60,000	9,766
Outer Drive					6	200	5,000	1,135

Table 13.
Summary of Fecal Coliform Densities
for the
North Shore Channel, North Branch of the Chicago River, and the Chicago River
June 28 through October, 1966

Sampling Location	No. of Samples	Counts / 100 ml. Minimum	Maximum	Geo. Mean
NSC 49.89 Linden	5	∠10	300	49
NSC 47.05 Dempster	8	∠100	24,000	1,544
NSC 46.05 Oakton	11	100	17,000	1,109
NSC 45.06 Touhy	13	8,000	91,000	30,190
NSC 44.04 Devon	7	10,000	60,000	36,190
NBCR 42.26 Argyle	12	1,500	90,000	25,580
NBCR 39.45 Western	13	15,000	280,000	56,110
NBCR 38.37 Fullerton	11	17,000	150,000	47,900
NBCR 37.50 Cortland	7	23,000	480,000	63,550
NBCR 36.85 North	8	13,000	720,000	43,700
NBCR 35.41 Chicago	4	19,000	1,100,000	68,350
NBCR 35.01 Grand	13	2,900	500,000	17,120
Chicago River				
CR 34.78 Wells	12	∠100	44,000	814
CR 34.86 LaSalle	4	100	56,000	1,832
CR 35.32 Michigan	4	100	27,000	3,507
CR 35.42 Outer Drive	6	∠100	2,600	193

Table 14.
Summary of Fecal Streptococci Densities
(Counts / 100 ml)
North Shore Channel, North Branch Chicago River, Chicago River

Sampling Location			September - October, 1965				July - October, 1966			
			No. of Obs.	Minimum	Maximum	Geo. Mean	No. of Obs.	Minimum	Maximum	Geo. Mean
NSC	49.89	Linden	5	/10	80	30	5	/10	/100	29
	49.23	Central	11	/10	4,200	470	-	-	-	-
	48.70	Green Bay	3	/10	10	/10	-	-	-	-
	47.85	Emerson	4	/10	40	20	-	-	-	-
	47.05	Dempster	6	/10	290	2,100	8	70	1,600	361
	46.05	Oakton	11	20	970	210	11	10	1,700	191
	45.06	Touhy	11	10	19,000	4,810	13	1,100	13,000	3,245
	44.04	Devon	-	-	-	-	7	1,300	7,000	2,882
	43.03	Bryn Mawr	8	700	29,000	6,720	-	-	-	-
NBC	42.26	Argyle	10	1,000	58,000	10,720	12	1,000	22,000	2,538
NBC	41.98	Lawrence	11	700	80,000	11,510	-	-	-	-
	40.35	Addison	11	1,200	57,000	10,170	-	-	-	-
	39.45	Western	-	-	-	-	14	700	13,000	3,470
	38.69	Damen	11	1,700	130,000	16,350	-	-	-	-
	38.37	Fullerton	-	-	-	-	11	800	12,000	2,875
	37.98	Ashland	8	2,400	110,000	15,680	-	-	-	-
	37.53	Cortland	-	-	-	-	7	400	5,000	1,686
	36.85	North	11	1,200	140,000	19,340	8	500	10,000	1,746
	36.32	Division	10	500	240,000	26,350	-	-	-	-
	35.90	Ogden	10	700	230,000	24,370	-	-	-	-
	35.41	Chicago	11	400	140,000	16,580	4	200	60,000	2,242
		Ontario	6	1,000	110,000	19,430	-	-	-	-
	35.01	Grand	-	-	-	-	13	180	70,000	929
NBC	34.82	Kinzie	11	440	130,000	20,060	-	-	-	-
Chicago River										
CR	34.78	Wells	7	/100	2,400	450	12	20	500	135
	34.86	LaSalle					4	100	3,900	612
	35.32	Michigan					4	100	8,000	1,021
		Outer Drive					6	/10	250	44

Table 15.
Summary of Total Coliform Densities for the South Branch of the Chicago River and the Chicago Sanitary & Ship Canal July through October, 1966

Sampling Location	No. of Samples	Counts / 100 ml.		
		Minimum	Maximum	Geo. Mean
SBCR 34.45 Randolph	13	7,000	140,000	36,900
SBCR 31.67 Halsted	9	1,000	70,000	9,359
SBCR 30.55 Ashland	13	3,300	220,000	13,815
CS&SC 29.43 Western	5	6,000	260,000	40,690
CS&SC 28.34 Kedzie	11	2,000	180,000	19,130
CS&SC 27.27 Pulaski	5	<1,000	280,000	21,360
CS&SC 26.47 Chic-West. RR (1)	4	200	21,000	3,916
CS&SC 26.20 Cicero	25	<1,000	700,000	20,170
CS&SC 25.73 Central	7	1,400	440,000	50,940
CS&SC 24.14 N. Ridgeland Lt.	13	700	4,900,000	145,900
CS&SC 22.98 Harlem	24	<1,000	5,700,000	110,200
CS&SC 22.38 Stevenson Exp. (1)	6	60,000	2,500,000	429,500
CS&SC 21.98 Lawndale	11	<10,000	3,200,000	232,500
CS&SC 19.98 Justice UL 311.0	8	40,000	4,800,000	321,500
CS&SC 18.37 US Hwys. 12-20-45	16	70,000	1,800,000	357,200
CS&SC 16.84 Willow Springs	12	27,000	820,000	163,800
CS&SC 13.08 Hwy. #83	15	45,000	850,000	145,900
CS&SC 11.94 Lemont L 302.9	4	58,000	140,000	80,300
CS&SC 9.51 Stephen	9	8,000	280,000	36,620
CS&SC 5.18 Romeo Highway	6	4,000	120,000	17,580

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(1) October samples only.

Table 16.
Summary of Fecal Coliform Densities for the South Branch of the Chicago River and the Sanitary & Ship Canal July through October, 1966

Sampling Location	No. of Samples	Counts / 100 ml.		
		Minimum	Maximum	Geo. Mean
SBCR 34.45 Randolph	12	3,500	44,000	12,601
SBCR 31.67 Halsted	8	1,800	15,000	5,336
SBCR 30.55 Ashland	12	200	27,000	2,844
CS&SC 29.43 Western	5	3,300	14,000	8,199
CS&SC 28.34 Kedzie	9	1,200	27,000	5,365
CS&SC 27.27 Pulaski	5	/100	30,000	1,391
CS&SC 26.47 Chic-West. RR(1)	3	2,300	17,000	4,544
CS&SC 26.20 Cicero	24	/100	180,000	4,425
CS&SC 25.73 Central	7	200	52,000	10,180
CS&SC 24.14 N. Ridgeland Lt.	10	10	900,000	23,980
CS&SC 22.98 Harlem	22	/100	1,200,000	26,410
CS&SC 22.38 Stevenson Exp.	5	15,000	1,100,000	95,140
CS&SC 21.98 Lawndale	10	3,000	1,200,000	79,290
CS&SC 19.98 Justice UL 311.0	7	6,000	1,400,000	91,290
CS&SC 18.37 US Hwy. 12-20-45	14	10,000	800,000	90,220
CS&SC 16.84 Willow Springs	12	6,000	150,000	29,500
CS&SC 13.08 Highway #83	14	2,000	90,000	20,910
CS&SC 11.94 Lemont L 302.9	4	4,000	51,000	13,960
CS&SC 9.51 Stephen	9	1,000	32,000	7,745
CS&SC 5.18 Romeo Highway	6	110	32,000	2,062

(1) October samples only.

Table 17.
Summary of Fecal Streptococci Densities for the South Branch of the Chicago River and the Chicago Sanitary & Ship Canal
July through October, 1966

Sampling Location	Samples	Counts / 100 ml. Minimum	Maximum	Geo. Mean
SBCR 34.45 Randolph	12	∠100	1,400	314
SBCR 31.67 Halsted	8	50	900	160
SBCR 30.55 Ashland	12	20	1,300	239
SSC 29.43 Western	5	60	5,000	538
SSC 28.34 Kedzie	10	50	1,200	224
SSC 27.27 Pulaski	5	∠10	1,300	82
SSC 26.47 Chic-West. RR(1)	4	40	400	99
SSC 26.20 Cicero	25	∠10	22,000	247
SSC 25.73 Central	7	∠10	1,700	247
SSC 24.14 N. Ridgeland Lt.	13	∠10	80,000	2,714
SSC 22.98 Harlem	23	∠10	120,000	13,580
SSC 22.38 Stevenson Exp.(1)	6	70	46,000	6,052
SSC 21.98 Lawndale	11	∠100	48,000	2,969
SSC 19.98 Justice UL 311.0	8	101	65,000	2,173
SSC 18.37 US Hwy. 12-20-45	15	100	43,000	2,482
SSC 16.84 Willow Spr.	12	300	39,000	1,216
SSC 13.08 Hwy. #83	14	20	2,800	216
SSC 11.94 Lemont L. 302.9	4	90	300	185
SSC 9.51 Stephen	9	∠10	7,000	222
SSC 5.18 Romeo Hwy.	6	10	∠1,000	137

(1) October samples only.

Table 18.
Summary of Total Coliform Densities From the Calumet River, Little Calumet River and Cal-Sag. Channel
July through October, 1966

Sampling Station	No. of Samples	Counts / 100 ml.		
		Minimum	Maximum	Geo. Mean
CH Calumet Harbor	12	40	24,000	320
CR 42.40 USL #333.4	11	130	1,500	520
CR 41.64 Ewing Avenue	13	/100	140,000	1,960
CR 41.33 95th Street	14	200	90,000	2,640
CR 40.67 100th Street	5	300	2,000	950
CR 39.81 106th Street	14	100	31,000	1,440
CR 37.74 #3 T.B.	5	1,000	11,000	3,060
CR 37.07 Torrence Avenue	12	300	8,000	1,670
CR 36.01 130th Street	10	100	2,900	760
CR 35.14 T.J.O. Lock	6	/100	700	270
LCR 31.34 Indiana Avenue	8	800	51,000	4,800
LCR 29.02 Halsted Street	9	31,000	2,300,000	241,000
CSC 27.99 Ashland Avenue	7	50,000	430,000	189,000
CSC 26.94 Western Avenue	4	61,000	410,000	118,000
CSC 26.01 Kedzie Avenue	6	53,000	1,300,000	179,000
CSC 23.97 Cicero Avenue	10	62,000	2,400,000	198,000
CSC 21.55 Ridgeland Avenue	5	44,000	1,400,000	238,000
CSC 20.55 Harlem Avenue	4	48,000	130,000	86,600
CSC 19.78 S.W. Expressway	5	32,000	1,900,000	172,000
CSC 17.52 U.S. #45	5	13,000	1,800,000	43,200
CSC 16.51 104th Street	11	1,000	260,000	28,800
CSC 15.23 X-Sect. Trans.	4	1,700	140,000	8,410
CSC 13.11 U.S. #83	15	1,700	1,700,000	11,500

Table 19.
Summary of Fecal Coliform Densities From the Calumet River, Little Calumet River and Cal-Sag. Channel July through October, 1966

Sampling Station			No. of Samples	Counts / 100 ml.		
				Minimum	Maximum	Geo. Mean
CH		Calumet Harbor	11	<5	50	12
CR	42.40	USL #333.4	11	10	490	52
CR	41.64	Ewing Avenue	12	20	28,000	360
CR	41.33	95th Street	13	190	31,000	900
CR	40.67	100th Street	5	110	330	180
CR	39.81	106th Street	13	30	1,600	280
CR	37.74	#3 T.B.	5	100	1,200	270
CR	37.07	Torrence Avenue	11	<100	3,100	240
CR	36.01	130th Street	9	10	770	180
CR	35.14	T.J.O. Lock	5	60	380	200
LCR	31.34	Indiana Avenue	8	90	26,000	730
LCR	29.02	Halsted Street	8	2,600	200,000	40,800
CSC	27.99	Ashland Avenue	6	27,000	80,000	44,500
CSC	26.94	Western Avenue	4	5,200	90,000	22,500
CSC	26.01	Kedzie Avenue	5	7,000	170,000	33,100
CSC	23.97	Cicero Avenue	10	16,000	520,000	20,100
CSC	21.55	Ridgeland Avenue	4	18,000	170,000	60,900
CSC	20.55	Harlem Avenue	4	4,000	54,000	14,600
CSC	19.78	S.W. Expressway	4	6,600	240,00	36,500
CSC	17.52	U.S. #45	5	600	120,000	4,590
CSC	16.51	104th Street	10	100	43,000	3,970
CSC	15.23	X-Sect. Trans.	4	100	21,000	1,080
CSC	13.11	U.S. #83	16	100	13,000	1,440

Table 20.
Summary of Fecal Streptococcus Densities From the Calumet River, Little Calumet River and Cal-Sag. Channel July through October, 1966

Sampling Station			No. of Samples	Counts / 100 ml.		
				Minimum	Maximum	Geo. Mean
CH		Calumet Harbor	11	/5	10	7
CR	42.40	USL #333.4	11	10	88	24
CR	41.64	Ewing Avenue	12	30	2,700	210
CR	41.33	95th Street	13	60	4,500	340
CR	40.67	100th Street	5	70	320	170
CR	39.81	106th Street	13	40	14,000	200
CR	37.74	#3 T.B.	5	120	390	220
CR	37.07	Torrence Avenue	11	50	6,400	190
CR	36.01	130th Street	9	10	430	87
CR	35.14	T.J.O. Lock	5	20	120	52
LCR	31.34	Indiana Avenue	8	20	500	71
LCR	29.02	Halsted Street	8	100	12,000	1,180
CSC	27.99	Ashland Avenue	6	300	2,900	1,120
CSC	26.94	Western Avenue	4	190	8,900	910
CSC	26.01	Kedzie Avenue	5	110	9,200	810
CSC	23.97	Cicero Avenue	10	500	23,000	4,090
CSC	21.55	Ridgeland Avenue	4	300	1,900	700
CSC	20.55	Harlem Avenue	4	390	2,000	880
CSC	19.78	S.W. Expressway	4	/10	3,100	280
CSC	17.52	U.S. #45	5	/10	1,000	90
CSC	16.51	104th Street	11	/10	1,200	59
CSC	15.23	X-Sect. Trans.	4	/10	/100	17
CSC	13.11	U.S. #83	16	/5	200	31

Table 21.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: Ewing Avenue 41.64 Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	0	5	10	18	22	25	7	12	18	0	13	25	49
DO	6.2	9.3	12.2	3.8	5.4	7.0	3.5	6.8	8.9	3.5	7.2	12.2	49
BOD	2	2	2	<1	<1	3	<1	2	4	<1	1	4	38
COD	4	10	18	5	10	23	4	16	24	4	12	24	50
Org. N	<0.1	2.3	3.9	<0.1	0.4	1.2	<0.1	1.6	2.4	<0.1	1.4	3.9	46
NH_3-N	<0.1	0.9	2.8	<0.1	0.1	0.7	<0.1	0.5	1.8	<0.1	0.5	2.8	48
NO_2^-+NO_3^--N	0.4	0.6	1.2	0.1	1.6	5.0	0.1	0.5	1.6	0.1	0.9	5.0	47
pH	7.4	7.9	8.2	6.8	8.0	8.5	6.6	7.9	8.4	6.6	7.9	8.4	50
Tot.Alk.as $CaCO_3$	100	138	195	100	116	138	84	117	160	84	123	195	50
Spec.Cond μmhos/cm	200	260	460	200	290	340	210	280	500	200	280	500	31
Cl^-	5	18	62	12	17	23	12	21	50	5	19	62	49
$SO_4^=$	20	39	140	10	17	24	16	24	52	10	26	140	45
Phenols ug/1	<1	21	85	<1	4	10	<1	5	20	<1	10	85	49
Hex. Sol.	1	25	78	1	4	38	1	70	320	1	34	320	51
Tot. $PO_4^=$	<0.01	0.04	0.13	<0.01	0.18	1.60	<0.01	0.10	0.45	<0.01	0.11	1.60	46

Winter	- December, January, February, March
Summer	- June, July, August, September
Spring-Fall	- April, May, October, November

Analyses are in mg/1 except pH and where otherwise indicated.

Table 22.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: 106th Street 39.81 Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	5	10	17	22	28	35	13	17	24	5	18	35	47
DO	4.9	8.1	11.4	3.5	4.4	6.2	3.2	5.9	7.5	3.2	6.2	11.4	48
BOD	1	2	2	∠1	2	6	∠1	3	11	∠1	2	11	35
COD	11	16	29	6	13	20	4	22	75	4	17	75	48
Org. N	0.4	1.9	8.2	0.3	1.6	2.4	∠0.1	1.2	5.0	∠0.1	1.3	8.2	44
NH_3-N	0.7	2.9	7.0	0.3	1.2	2.3	0.2	1.4	4.6	0.3	1.8	7.0	45
NO_2^-+NO_3^--N	0.2	0.7	2.2	0.4	2.6	4.8	0.3	0.7	1.9	0.2	1.3	4.8	46
pH	7.4	7.7	8.1	7.3	7.7	8.1	7.1	7.7	8.1	7.1	7.7	8.1	49
Tot.Alk.as $CaCO_3$	94	123	155	110	115	120	106	118	150	94	119	155	49
Spec.Cond $\mu\frac{mhos}{cm}$	220	340	680	280	360	420	200	310	450	200	340	680	28
Cl^-	8	36	104	16	39	110	17	43	142	8	40	142	48
$SO_4^=$	28	50	100	24	34	42	23	38	104	23	40	104	44
Phenols ug/l	2	25	144	∠1	4	11	∠1	4	12	∠1	11	144	48
Hex. Sol.	∠1	28	108	∠1	8	80	∠1	78	291	∠1	40	291	49
Tot. $PO_4^=$	Z0.01	0.05	0.12	Z0.01	0.27	1.17	Z0.01	0.07	0.44	Z0.01	0.13	1.17	42

Winter	- December, January, February, March
Summer	- June, July, August, September
Spring-Fall	- April, May, October, November

Analyses are in mg/l except pH and where otherwise indicated.

Table 23
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: Torrence Avenue 37.07 Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	3	9	15	22	26	30	13	17	22	3	17	30	49
DO	2.6	6.1	10.7	1.1	2.4	4.8	1.3	4.1	5.3	1.1	4.3	10.7	49
BOD	2	3	4	/1	3	11	2	4	15	/1	3	15	36
COD	8	21	43	10	15	23	11	22	32	8	19	43	49
Org. N	/0.1	1.5	5.6	/0.1	1.1	4.9	0.4	1.6	3.4	/0.1	1.4	5.6	47
NH_3-N	2.1	3.3	7.0	0.2	1.5	2.8	1.4	2.3	3.9	0.2	2.3	7.0	47
NO_2^-+NO_3^--N	0.2	0.6	1.3	0.2	2.9	6.5	0.2	0.9	1.8	0.2	1.5	6.5	47
pH	6.7	7.4	8.0	6.1	7.2	7.8	7.2	7.5	7.8	6.7	7.4	8.0	50
Tot.Alk.as $CaCO_3$	96	111	130	60	98	115	100	117	165	60	109	165	50
Spec.Cond /$\frac{\mu mhos}{cm}$	260	400	600	280	410	510	340	350	400	260	390	600	30
Cl^-	28	48	72	22	39	57	29	49	104	22	46	104	49
$SO_4^=$	40	75	119	31	71	152	33	64	142	31	69	152	44
Phenols ug/1	4	14	46	/1	3	11	/1	4	23	/1	7	46	49
Hex. Sol.	1	22	48	/1	6	30	/1	73	235	/1	36	235	49
Tot. $PO_4^=$	/0.01	0.07	0.30	/0.01	0.39	2.30	/0.01	0.09	0.57	/0.01	0.26	2.30	34

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/1 except pH and where otherwise indicated.

Table 24.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: 130th Street 36.01 Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	0	7	13	20	25	29	10	15	21	0	15	29	49
DO	5.1	7.2	10.5	1.3	3.2	4.6	1.1	4.9	6.6	1.1	5.1	10.5	49
BOD	2	3	6	∠1	3	6	∠1	5	11	∠1	4	11	34
COD	8	22	50	10	17	21	12	25	60	8	21	60	48
Org. N	0.4	1.4	4.2	∠0.1	0.7	2.5	0.1	1.5	3.2	∠0.1	1.2	4.2	43
NH_3-N	2.1	3.3	5.6	∠0.1	1.5	2.7	0.6	2.3	3.9	∠0.1	2.4	5.6	45
NO_2^-+NO_3^--N	0.3	1.0	2.0	0.6	3.7	7.0	0.2	1.1	2.4	0.3	1.9	7.0	45
pH	7.2	7.6	8.0	6.8	7.3	7.8	7.3	7.6	8.1	6.8	7.5	8.1	49
Tot.Alk.as $CaCO_3$	98	118	155	43	103	135	105	120	155	43	114	155	18
Spec.Cond μmhos/cm	290	430	600	340	470	580	350	390	420	290	430	600	30
Cl^-	37	58	83	26	48	78	34	55	100	26	54	100	47
$SO_4^=$	50	96	200	42	82	128	28	69	140	28	81	200	38
Phenols ug/1	4	10	28	∠1	5	12	∠1	11	81	∠1	8	81	47
Hex. Sol.	∠1	29	112	∠1	12	38	∠1	105	397	∠1	52	397	47
Tot. $PO_4^=$	∠0.01	0.11	0.50	∠0.01	0.49	1.32	∠0.01	0.16	0.91	∠0.01	0.30	1.32	34

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/1 except pH and where otherwise indicated.

Table 25.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station:
Torrence Avenue 34.83 Grand Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	0	6	11	16	22	25	4	11	19	0	13	25	46
DO	0.5	4.6	10.2	/0.1	1.7	4.6	/0.1	2.9	7.8	0.5	3.0	10.2	46
BOD	3	6	7	/1	8	25	4	13	36	/1	11	36	36
COD	14	52	120	17	43	83	29	62	98	14	52	120	46
Org. N	1.0	3.4	5.6	/0.1	2.2	4.2	1.4	3.0	5.2	/0.1	2.8	5.6	43
NH_3-N	2.8	5.7	9.4	/0.1	2.8	5.9	1.4	4.9	10.0	/0.1	4.4	10.0	44
NO_2^-+NO_3^--N	0.8	1.7	3.8	0.6	7.0	18.9	0.3	1.5	4.4	0.3	3.5	18.9	45
pH	6.6	7.5	7.8	7.0	7.3	7.7	7.2	7.4	7.7	6.6	7.4	7.8	47
Tot.Alk.as $CaCO_3$	144	183	230	118	165	220	140	204	470	118	189	470	47
Spec.Cond μmhos/cm	560	750	940	460	700	950	550	700	900	460	710	950	27
Cl^-	63	98	241	35	65	90	19	70	89	19	76	241	46
$SO_4^=$	115	186	255	30	126	193	78	154	215	30	128	255	43
Phenols ug/l	2	17	39	/1	5	11	/1	9	26	/1	10	39	46
Hex. Sol.	2	43	138	/1	19	60	/1	90	359	/1	53	359	46
Tot. $PO_4^=$	3.40	4.96	7.80	0.64	6.48	16.80	1.70	4.15	7.26	0.64	5.47	16.80	33

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/l except pH and where otherwise indicated.

Table 26.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: Indiana Avenue 31.34 Little Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	0	5	12	19	24	28	8	13	19	0	14	28	48
DO	4.5	7.0	9.5	0.5	3.6	5.1	1.0	5.0	6.6	0.5	5.2	9.5	49
BOD	3	6	9	∠1	4	9	2	7	18	∠1	5	18	38
COD	8	35	80	16	25	37	11	36	67	8	32	80	50
Org. N	0.7	1.4	2.6	∠0.1	1.1	2.8	0.6	1.9	3.2	∠0.1	1.5	3.2	47
NH_3-N	2.8	3.6	5.6	∠0.1	1.4	3.2	1.0	2.6	6.0	∠0.1	2.4	6.0	47
NO_2^-+NO_3^--N	0.4	1.1	1.5	0.8	3.9	7.0	0.5	1.4	2.2	0.4	2.2	7.0	47
pH	6.3	7.5	7.9	7.3	7.5	7.9	7.1	7.5	7.9	6.3	7.5	7.9	50
Tot.Alk.as $CaCO_3$	60	117	150	85	110	120	106	129	175	60	119	175	50
Spec.Cond μmhos/cm	350	470	650	350	480	620	310	400	450	310	490	650	28
Cl^-	39	61	95	27	52	95	37	56	108	27	55	108	49
$SO_4^=$	36	89	140	39	77	143	40	79	183	36	81	183	45
Phenols ug/1	-	-	-	-	-	-	-	-	-	-	-	-	-
Hex. Sol.	∠1	32	112	∠1	5	30	∠1	90	285	∠1	43	285	49
Tot. $PO_4^=$	∠0.01	0.57	2.30	0.20	0.75	2.00	0.04	1.29	4.50	∠0.01	0.90	4.50	49

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/1 except pH and where otherwise indicated.

Table 27.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: Halsted Street 29.02 Little Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	0	7	12	20	24	27	8	13	19	0	15	27	49
DO	3.1	5.4	7.9	/0.1	3.0	5.2	1.3	4.0	5.9	/0.1	4.1	7.9	49
BOD	3	5	9	/1	5	17	3	6	9	/1	6	17	37
COD	14	45	70	23	34	49	26	41	59	14	45	70	51
Org. N	1.0	3.0	10.5	0.1	2.0	5.9	0.2	1.6	3.5	0.1	2.1	10.5	48
NH_3-N	5.2	9.7	14.0	1.6	6.0	8.3	3.6	7.0	9.8	1.6	7.4	14.0	33
NO_2^-+NO_3^--N	0.6	0.9	1.5	1.6	4.8	14.0	0.5	1.2	2.5	0.6	2.4	14.0	48
pH	7.1	7.4	7.9	6.7	7.1	7.4	7.0	7.3	7.7	6.7	7.2	7.9	51
Tot.Alk.as $CaCO_3$	125	156	212	85	129	155	125	162	345	85	149	345	51
Spec.Cond μmhos/cm	500	720	1000	460	690	900	370	580	700	370	660	1000	31
Cl^-	56	108	206	40	72	111	62	78	105	40	85	206	50
$SO_4^=$	96	190	323	77	157	205	108	172	255	77	171	323	46
Phenols ug/l	-	-	-	-	-	-	-	-	-	-	-	-	-
Hex. Sol.	2	41	96	/1	9	25	1	94	481	1	47	481	50
Tot. $PO_4^=$	/0.01	0.80	2.00	0.40	2.32	7.60	0.20	1.80	4.90	/0.01	1.67	7.60	50

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/l except pH and where otherwise indicated

Table 28.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: Ashland Avenue 27.99 Calumet Sag Channel

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	0	6	12	18	20	27	8	12	19	0	14	27	47
DO	3.1	5.8	8.1	<0.1	2.4	5.0	1.6	4.2	6.3	<0.1	4.2	8.1	49
BOD	3	6	10	2	6	11	2	6	13	2	6	13	35
COD	23	45	68	21	38	53	27	44	70	21	43	70	49
Org. N	1.0	3.6	13.0	0.7	2.1	3.3	0.2	1.9	5.4	0.2	2.7	13.0	45
NH_3-N	1.2	6.8	9.8	1.1	6.4	10.5	1.0	5.7	7.9	1.0	6.2	10.5	45
NO_2^-+NO_3^--N	0.3	1.2	2.4	1.6	4.1	14.2	0.4	1.3	3.2	0.3	2.2	14.2	45
pH	7.0	7.4	7.7	6.9	7.2	7.5	7.1	7.4	7.9	6.9	7.3	7.9	48
Tot.Alk.as $CaCO_3$	125	166	210	130	151	173	128	165	195	125	161	210	47
Spec.Cond μmhos/cm	570	780	900	520	800	1000	600	660	800	520	750	1000	28
Cl^-	67	113	251	52	92	118	72	86	105	52	96	251	48
$SO_4^=$	94	186	238	90	179	235	115	179	255	90	181	255	45
Phenols ug/l	2	34	146	1	21	172	<1	9	27	<1	21	172	47
Hex. Sol.	<1	36	102	<1	8	22	<1	64	325	<1	38	325	48
Tot. $PO_4^=$	0.54	2.07	3.90	1.50	3.55	8.50	0.08	2.75	5.70	0.08	2.79	8.50	48

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/l except pH and where otherwise indicated.

Table 29.

Summary of Chemical and Physical Analyses of Water Quality Calumet Area Surveillance Program

Station: Ashland Avenue 29.18 Branch Little Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	2	5	11	15	23	27	5	11	18	2	14	27	44
DO	0.6	5.6	8.9	0.6	4.0	9.9	1.2	4.2	8.7	0.6	4.5	9.9	45
BOD	4	6	8	5	7	12	2	5	15	2	6	15	36
COD	28	58	128	33	46	63	30	46	79	28	48	128	46
Org. N	0.7	2.4	4.0	1.3	2.8	6.0	0.2	2.2	4.0	0.2	2.5	6.0	44
NH_3-N	1.4	3.6	7.6	3.7	6.7	9.9	0.4	4.0	7.8	0.4	4.9	9.9	43
NO_2^-+NO_3^--N	0.4	2.0	3.6	0.4	6.9	13.4	0.3	1.9	4.2	0.3	3.8	13.4	44
pH	7.5	7.7	7.9	7.4	7.7	8.1	7.3	7.6	8.0	7.3	7.7	8.1	46
Tot.Alk.as $CaCO_3$	120	213	290	228	287	345	160	247	310	120	275	345	44
Spec.Cond µmhos/cm	520	850	1030	1200	1640	2000	750	990	1220	520	1290	2000	28
Cl^-	76	131	264	153	260	366	60	138	239	60	180	366	45
$SO_4^=$	106	194	260	190	288	370	100	209	285	100	235	370	43
Phenols ug/1	/1	14	47	/1	9	23	/1	13	70	/1	12	70	43
Hex. Sol.	/1	42	108	/1	13	30	/1	91	343	/1	51	343	46
Tot. $PO_4^=$	1.05	5.41	9.72	2.29	25.40	80.90	0.17	9.89	43.50	0.17	14.10	80.90	46

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/l except pH and where otherwise indicated.

Table 30.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: Indiana Avenue 33.53 Branch Little Calumet River

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	2	4	11	14	22	27	6	12	19	2	13	27	39
DO	3.7	5.6	8.5	0.1	3.4	8.0	1.4	4.0	4.8	0.1	4.4	8.5	39
BOD	4	5	8	4	7	9	/1	6	15	/1	7	15	26
COD	18	49	159	34	44	56	32	44	60	18	47	159	39
Org. N	0.9	2.4	9.6	0.8	2.4	3.8	1.4	2.1	2.8	0.8	2.3	9.6	36
NH_3-N	1.4	3.8	14.5	3.4	8.0	12.4	0.4	2.8	4.9	0.4	5.5	14.5	35
$NO_2^-+NO_3^-$-N	0.8	1.5	3.6	1.9	5.9	10.2	0.8	1.6	3.4	0.8	3.4	10.2	35
pH	7.6	7.7	8.0	7.0	7.7	8.0	7.4	7.6	7.9	7.4	7.6	8.0	38
Tot.Alk.as $CaCO_3$	115	228	325	150	310	364	155	214	275	115	258	364	39
Spec.Cond μmhos/cm	600	1000	1400	900	1580	2100	-	-	-	600	1370	2100	21
Cl^-	79	147	270	143	256	394	50	116	164	50	186	394	38
$SO_4^=$	92	193	298	155	307	357	100	196	285	92	241	357	36
Phenols ug/1	/1	11	33	2	8	23	/1	8	20	/1	10	33	39
Hex. Sol.	/1	29	92	/1	13	30	/1	131	333	/1	45	333	38
Tot. $PO_4^=$	2.60	9.90	25.80	19.00	27.18	40.20	0.70	10.22	23.00	0.70	17.00	40.20	47

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/1 except pH and where otherwise indicated.

Table 31.

Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: Carondolet Road Wolf Lake Ditch

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	0	3	11	14	22	26	4	11	18	0	12	26	49
DO	8.0	11.1	13.1	4.5	6.3	8.0	7.1	9.0	11.1	4.5	8.0	13.1	49
BOD	2	3	4	/1	2	7	2	3	4	/1	2	7	35
COD	14	27	43	12	20	31	8	26	93	8	25	93	49
Org. N	0.5	1.2	2.6	/0.1	1.0	2.8	/0.1	1.4	2.4	/0.1	1.1	2.8	46
NH_3-N	/0.1	0.2	0.9	/0.1	0.0	0.4	/0.1	0.3	0.7	/0.1	0.2	0.9	46
NO_2^-+NO_3^--N	0.1	0.6	2.0	0.4	1.3	3.0	0.2	0.5	0.8	0.1	0.8	2.0	46
pH	7.6	8.6	9.1	8.3	8.6	9.4	7.8	8.6	9.9	7.6	8.6	9.9	49
Tot.Alk.as $CaCO_3$	104	124	145	80	96	110	94	120	150	80	113	150	49
Spec.Cond μmhos/cm	330	360	400	380	400	480	350	360	400	330	380	480	28
Cl^-	33	39	55	33	40	46	33	36	42	33	38	55	48
$SO_4^=$	52	65	84	52	65	78	34	58	102	34	63	102	44
Phenols ug/1	-	-	-	-	-	-	-	-	-	-	-	-	-
Hex. Sol.	1	14	37	/1	1	8	/1	17	50	/1	11	50	48
Tot. $PO_4^=$	/0.01	0.02	0.09	/0.01	0.20	0.56	/0.01	0.01	0.06	/0.01	0.09	0.56	47

Winter - December, January, February, March
Summer - June, July, August, September
Spring-Fall - April, May, October, November

Analyses are in mg/1 except pH and where otherwise indicated.

Table 32.
Summary of Chemical and Physical Analyses of Water Quality
Calumet Area Surveillance Program

Station: Wolf Lake Spillway - Wolf Lake

Parameter	Winter			Summer			Spring-Fall			Yearly Oct. 1965 through Oct. 1966			
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	No. of Samples
Temp. °C	0	4	10	15	22	26	4	11	19	0	12	26	48
DO	8.0	11.1	13.7	5.3	7.2	8.9	6.4	9.3	11.7	5.3	9.2	13.7	49
BOD	2	3	3	/1	1	3	1	3	4	/1	2	4	35
COD	15	22	34	12	19	31	12	22	39	12	21	39	48
Org. N	/0.1	4.2	21.0	/0.1	0.8	1.8	/0.1	2.4	23.2	/0.1	2.3	23.2	45
NH_3-N	/0.1	0.4	1.7	/0.1	0.1	0.8	/0.1	1.4	6.0	/0.1	0.7	6.0	45
NO_2^-+NO_3^--N	0.1	0.5	1.0	0.6	1.3	2.8	0.2	0.8	6.4	0.1	0.9	6.4	45
pH	7.6	8.1	8.4	7.2	8.3	8.6	7.8	8.2	8.4	7.2	8.2	8.6	49
Tot.Alk.as $CaCO_3$	104	126	145	95	101	113	100	115	150	95	114	150	48
Spec.Cond μmhos/cm	300	340	400	360	390	440	320	360	480	300	370	480	28
Cl^-	27	34	39	33	39	44	30	34	40	27	36	44	48
$SO_4^=$	46	56	86	52	61	81	40	51	90	40	56	90	44
Phenols ug/1	-	-	-	-	-	-	-	-	-	-	-	-	-
Hex. Sol.	/1	16	59	/1	1	11	/1	11	50	/1	9	59	47
Tot. $PO_4^=$	/0.01	0.07	0.37	/0.01	0.20	0.60	/0.01	0.04	0.30	/0.01	0.09	0.60	46

Winter	- December, January, February, March
Summer	- June, July, August, September
Spring-Fall	- April, May, October, November

Analyses are in mg/1 except pH and where otherwise indicated.

Table 33.
Summary of Chemical and Physical Analyses
Calumet River Survey - 1965
(June 21 to August 4, 1965)

		Sampling Stations					
Parameter		CH 43.14 Breakwater Entrance	CR 42.40 Mouth Calumet R.	CR 41.64 Ewing Avenue	CR 39.81 106th Street	CR 37.07 Torrence	CR 36.01 130th Street
Temp. °C.	Min.	17	18.5	18	23	27	25
	Max.	24	25	25	29	29.5	28
	Mean	20	21	21	27	28	27
DO mg/l	Min.	7.5	5.9	5.3	4.0	1.8	2.7
	Max.	9.0	8.0	7.4	5.4	4.1	4.3
	Mean	8.1	7.2	6.3	4.6	1.9	3.2
COD mg/l	Min.	7	7	7	7	11	14
	Max.	61	73	92	169	59	49
	Mean	22	20	28	42	29	25
Spec. Cond. umhos/cm	Min.	260	270	270	315	340	360
	Max.	275	380	380	390	410	420
	Mean	270	283	289	336	374	391
Chlorides mg/l	Min.	2	7	8	14	19	25
	Max.	9	10	11	42	32	32
	Mean	7	8	10	20	24	29
Sulfates mg/l	Min.	11	12	12	25	37	44
	Max.	27	25	32	42	60	63
	Mean	20	22	23	33	49	51
pH	Min.	7.4	7.4	7.4	7.4	7.2	7.3
	Max.	7.8	7.8	7.7	7.7	7.6	7.5
	Mean	7.6	7.6	7.5	7.5	7.4	7.4
Tot. Alk. as $CaCO_3$	Min.	88	78	41	97	67	87
	Max.	142	128	122	122	118	120
	Mean	93	107	106	110	95	108
Org.-N mg/l	Min.	0.2	0.2	0.2	0.2	0.6	0.2
	Max.	1.0	1.0	1.0	1.8	1.6	2.0
	Mean	0.5	0.6	0.6	0.8	1.0	1.1
NH_3-N mg/l	Min.	0.2	0.2	0.2	0.5	1.4	1.6
	Max.	0.5	0.5	0.5	1.5	3.2	2.4
	Mean	0.3	0.3	0.3	1.0	2.1	2.1
NO_3-NO_3 mg/l	Min.	0.2	0.2	0.2	0.2	0.2	0.4
	Max.	0.8	0.4	0.4	0.6	0.9	0.9
	Mean	0.4	0.3	0.3	0.4	0.5	0.7
Phenols ug/l	Min.	<1	<1	<1	<1	<1	<1
	Max.	138.0	22.8	10.3	13.0	22.3	4.3
	Mean	19.5	3.9	3.8	3.9	5.9	1.7

TABLE 34.
Mineral Constituent Levels
Calumet Area Surveillance
January through September, 1966

Station Location		Calcium (Ca^{++})	Magnesium (Mg^{++})	Potassium (K^{+})	Sodium (Na^{+})
CR 41.64	Min.	33.8	9.4	1.4	4.8
Ewing Avenue	Max.	55.5	14.6	5.7	28.7
Calumet River	Median	43.0	12.0	2.6	6.8
No. of Samples - 38					
CR 39.81	Min.	34.3	10.0	1.8	5.2
106th Street	Max.	66.3	15.2	11.6	78.5
Calumet River	Median	46.5	13.2	5.8	13.5
No. of Samples - 38					
CR 37.07	Min.	34.5	10.8	2.3	7.4
Torrence Avenue	Max.	82.5	26.3	10.8	55.7
Calumet River	Median	50.0	14.1	6.8	24.7
No. of Samples - 36					
CR 36.01	Min.	31.5	11.4	2.8	11.6
130th Street	Max.	85.0	19.6	11.0	56.6
Calumet River	Median	54.5	15.1	7.1	30.0
No. of Samples - 36					
GCR 34.83	Min.	39.3	14.0	5.5	21.5
Torrence Avenue	Max.	140.5	41.0	11.5	148.5
Grand Calumet River	Median	86.0	21.6	8.1	61.0
No. of Samples - 33					
LCR 31.34	Min.	39.3	11.9	3.8	12.4
Indiana Avenue	Max.	95.0	31.0	13.0	82.0
Little Calumet R.	Median	65.8	17.4	7.5	30.0
No. of Samples - 36					
LCR 29.02	Min.	46.5	12.6	4.3	21.1
Halsted	Max.	112.8	41.5	19.4	162.0
Little Calumet R.	Median	78.3	23.0	8.4	63.0
No. of Samples - 36					
CSC 27.99	Min.	48.3	14.7	5.2	30.8
Ashland	Max.	121.2	42.0	13.3	163.5
Cal-Sag Channel	Median	82.8	26.0	8.5	70.0
No. of Samples - 36					

TABLE 34. (continued)

Station Location		Calcium (Ca^{++})	Magnesium (Mg^{++})	Potassium (K^{+})	Sodium (Na^{+})
BLC 29.18	Min.	68.0	24.6	4.5	33.5
Ashland	Max.	174.0	74.0	21.8	222.0
Little Cal. R.	Median	111.8	45.5	9.5	111.0
No. of Samples - 32					
BLC 33.53	Min.	49.0	25.9	4.5	30.7
Indiana	Max.	174.2	78.0	20.0	226.0
Little Cal. R.	Median	119.8	44.5	9.8	114.0
No. of Samples - 35					
WLD	Min.	27.0	9.5	3.7	20.0
Wolf Lake Spillway	Max.	114.5	44.0	5.7	31.8
No. of Samples -36	Median	49.0	13.0	4.7	22.7
WLD	Min.	29.3	7.4	4.7	21.0
Carondolet Road	Max.	104.2	14.8	13.2	29.1
Wolf Lake Ditch	Median	53.5	12.8	6.9	25.9
No. of Samples - 36					

TABLE 35
Summary of Heavy Metals Analyses
Calumet Area Surveillance
October 1965 - October 1966

	Mn	Cu	Zn
Detection Limit (dl) - mg/l	0.02	0.03	0.01
Station: CR 41.64 Ewing Ave. Cal.Riv.			
No. of obs. above dl	35	1	38
No. of samples	38	38	38
Range - mg/l	bdl-0.50	bdl 0.20	0.03-0.040
Station: CR 39.81 106th St. Cal. Riv.			
No. of obs. above dl	36	0	38
No. of samples	38	38	38
Range - mg/l	0.04-0.90	bdl 0.03	0.07-0.40
Station: CR 37.07 Torrence Ave. Cal.Riv.			
No. of obs. above dl	36	0	36
No. of samples	36	36	36
Range- mg/l	0.11-1.33	bdl 0.03	0.07-0.38
Station: CR 36.01 130th St. Cal. Riv.			
No. of obs. above dl	36	1	36
No. of samples	36	36	36
Range - mg/l	0.04-0.65	0.03-25.8	0.04-0.45
Station:GCR 34.83 Torrence Ave. Gr.Cal.Riv.			
No. of obs. above dl	32	0	33
No. of samples	33	33	33
Range - mg/l	bdl -0.50	bdl	0.05-0.42
Station: LCR 31.34 Indiana Avenue			
No. of obs. above dl	36	3	36
No. of samples	36	36	36
Range - mg/l	0.10-0.60	bdl-5.0	0.06-0.47
Station:LCR 29.02 Halsted Street			
No. of obs. above dl	36	2	35
No. of samples	36	36	36
Range - mg/l	0.08-14.03	bdl-015	0.07-2.00
Station: CSC 27.99 Ashland Avenue			
No. of obs. above dl	35	2	36
No. of samples	36	36	36
Range - mg/l	bdl 1.15	bdl- 0.65	0.09-1.04

TABLE 35 (Continued)

Detection Limit (dl) - mg/l	Mn 0.02	Cu 0.03	Zn 0.01
Station: Br. LC 29.18 Ashland Avenue			
No. of obs. above dl	29	0	29
No. of samples	32	32	32
Range - mg/l	bdl-0.50	bdl	bdl-0.34
Station: W.L.D. Wolf Lake Spillway			
No. of obs. above dl	22	1	25
No. of samples	36	36	36
Range - mg/l	bdl - 0.25	bdl-0.06	bdl-0.24
Station: W.L.D. Carondolet Road			
No. of obs. above dl	22	1	25
No. of samples	36	36	36
Range - mg/l	bdl-3.86	bdl-0.05	bdl-0.24

Note:

Other heavy metals were below detection limits on the majority of samples analyzed. Out of 428 samples:

Cr	1 value	dl	(0.02)
Ni	5 values	dl	(0.03)
Cd	4 values	dl	(0.01)
Pb	All values	dl	(0.10)

Table 36.
Summary of Total Coliform Results
Calumet Area Surveillance Data (10/65 to 10/66)

Station Location	Period	No. of Samples	Total Coliform Counts / 100 ml. Minimum	Maximum	Geo. Mean
CR 41.64 Ewing Avenue Calumet R.	Winter		40	7,400	162
	Summer		160	44,000	1,550
	Spr.-Fall		80	34,000	1,050
	Total Period	53	40	44,000	633
CR 39.81 106th Street Calumet R.	Winter		10	37,500	302
	Summer		410	11,000	1,390
	Spr.-Fall		180	1,000	434
	Total Period	53	10	37,500	543
CR 37.07 Torrence Calumet R.	Winter		120	25,000	1,880
	Summer		700	3,000	1,480
	Spr.-Fall		300	31,000	1,330
	Total Period	53	120	31,000	1,450
CR 36.01 130th Street Calumet River	Winter		10	2,700	458
	Summer		200	77,000	1,117
	Spr.-Fall		200	1,700	669
	Total Period	49	10	77,000	710
GCR 34.83 Torrence Gr. Calumet R.	Winter		2,000	46,000	53,000
	Summer		8,000	900,000	163,000
	Spr.-Fall		5,500	450,000	258,000
	Total Period	46	2,000	900,000	140,000
LCR 31.34 Indiana Avenue Little Cal. R.	Winter		1,000	88,000	15,700
	Summer		900	100,000	7,150
	Spr.-Fall		7,000	1,300,000	42,300
	Total Period	49	900	1,300,000	16,700

Table 36. (continued)

Station Location	Period	No. of Samples	Total Coliform Counts / 100 ml.		
			Minimum	Maximum	Geo. Mean
LCR 29.02 Halsted Street Little Cal. R.	Winter		20,000	410,000	88,300
	Summer		10,000	11,000,000	355,000
	Spr.-Fall		46,000	1,500,000	156,000
	Total Period	49	10,000	11,000,000	170,000
CSC 27.99 Ashland Avenue Cal Sag Channel	Winter		26,000	250,000	80,800
	Summer		40,000	3,100,100	301,000
	Spr.-Fall		32,000	1,100,000	130,000
	Total Period	49	26,000	3,100,000	147,000
BLCR 29.18 Ashland Avenue Br. Little Calumet River	Winter		14,000	540,000	58,300
	Summer		13,000	900,000	77,200
	Spr.-Fall		5,100	320,000	41,100
	Total Period	45	5,100	900,000	56,500
BLCR 33.53 Indiana Avenue Br. Little Calumet River	Winter		6,000	510,100	62,400
	Summer		9,000	660,000	54,700
	Spr.-Fall		4,700	270,000	78,500
	Total Period	39	4,700	660,000	62,300
WLD 126th Street Wolf Lake Spillway	Winter		5	30	9
	Summer		28	600	97
	Spr.-Fall		5	220	29
	Total Period	49	5	600	29
WLD Carondolet Rd. Wolf Lake Ditch	Winter		5	200	23
	Summer		330	24,000	1,750
	Spr.-Fall		10	400	194
	Total Period	49	5	24,000	199

(1) Analyses by Membrane Filter Technique

(2) Winter period - Dec., 1965, Jan., Feb., March, 1966
Summer period - June, July, Aug., Sept., 1966
Spring-Fall period - May, June, 1966, Sept., Oct., 1965

TABLE 37.
Summary of Fecal Coliform Results
Calumet Area Surveillance Data (6/66 to 10/66)

Station Location	No. of Samples	Fecal Coliform Counts / 100 ml. Minimum	Maximum	Geo. Mean
CR 41.64 Calumet River Ewing Avenue	16	28	44,000	371
CR 39.81 Calumet River 106th Street	16	70	1,900	267
CR 37.07 Calumet River Torrence	16	70	3,000	450
CR 36.01 Calumet River 130th Street	16	20	13,000	216
GCR 34.83 Grand Calumet River Torrence	16	500	1,300,000	29,900
LCR 31.34 Little Calumet River Indiana Avenue	16	150	20,000	2,200
LCR 29.02 Little Calumet River Halsted Street	16	10,000	490,000	82,500
CSC 27.99 Cal Sag Channel Ashland Avenue	16	10,000	900,000	67,100
BLCR 29.18 Branch Little Calumet River Ashland Avenue	16	2,300	90,000	10,300
BLCR 33.53 Branch Little Calumet River Indiana Avenue	16	700	90,000	11,800
Wolf Lake Spillway 126th Street	16	∠5	290	77
Wolf Lake Ditch Carondolet Road	16	30	1,000	195

Table 38.
Summary of Fecal Streptococcus Results
Calumet Area Surveillance Data (10/65 to 10/66)

Station Location	Period	No. of Samples	Fecal Strep Counts / 100 ml. Minimum	Maximum	Geo. Mean
CR 41.64 Ewing Avenue Calumet R.	Winter	18	15	700	79
	Summer	16	10	410	155
	Spr.-Fall	19	8	2,200	130
	Total Period	53	8	2,200	116
CR 39.81 106th Street Calumet R.	Winter	18	30	1,060	100
	Summer	16	5	3,500	143
	Spr.-Fall	19	110	380	82
	Total Period	53	5	3,500	95
CR 37.07 Torrence Calumet R.	Winter	16	60	16,000	294
	Summer	16	50	10,000	493
	Spr.-Fall	19	10	5,000	239
	Total Period	51	10	16,000	320
CR 36.01 130th Street Calumet R.	Winter	16	<10	1,800	56
	Summer	16	<5	340	116
	Spr.-Fall	16	5	800	81
	Total Period	48	<5	1,800	81
GCR 34.83 Torrence Gr. Calumet R.	Winter	13	50	44,000	1,480
	Summer	16	<5	119,000	878
	Spr.-Fall	16	42	54,000	1,630
	Total Period	45	<5	119,000	1,270
LCR 31.34 Indiana Avenue Little Cal. R.	Winter	16	<10	620	590
	Summer	16	30	3,300	99
	Spr.-Fall	16	<100	42,000	553
	Total Period	48	<10	42,000	319

Table 38. (continued)

Station Location	Period	No. of Samples	Fecal Strep Counts / 100 ml. Minimum	Maximum	Geo. Mean
LCR 29.02 Halsted Street Little Cal. R.	Winter	16	100	45,000	12,200
	Summer	16	900	51,000	1,690
	Spr.-Fall	16	200	110,000	5,090
	Total Period	48	100	110,000	4,730
CSC 27.99 Ashland Avenue Cal Sag Channel	Winter	16	<100	46,000	8,630
	Summer	16	700	110,000	2,110
	Spr.-Fall	16	380	48,000	3,500
	Total Period	48	<100	110,000	3,990
BLCR 29.18 Ashland Avenue Br. Little Calumet River	Winter	11	<100	48,000	4,140
	Summer	16	300	110,000	641
	Spr.-Fall	16	<100	28,000	1,260
	Total Period	43	<100	110,000	1,330
BLCR 33.53 Indiana Avenue Br. Little Calumet River	Winter	14	50	90,000	4,100
	Summer	16	<100	50,000	561
	Spr.-Fall	9	300	35,000	2,240
	Total Period	39	50	90,000	1,580
WLD 126th Street Wolf Lake Spillway	Winter	16	5	590	8
	Summer	16	<5	300	18
	Spr.-Fall	17	2	130	10
	Total Period	47	2	590	11
WLD Carondolet Road Wolf Lake Ditch	Winter	16	28	380	12
	Summer	16	<5	130	153
	Spr.-Fall	16	<5	140	310
	Total Period	48	<5	380	82

(1) Analyses by Membrane Filter Technique
(2) Winter period - Dec., 1965, Jan., Feb., March, 1966
Summer period - June, July, Aug., Sept., 1966
Spring-Fall period - May, June, 1966, Sept., Oct., 1965

TABLE 39.

SUMMARY OF TOTAL COLIFORM AND FECAL STREPTOCOCCUS RESULTS
CALUMET RIVER SURVEY 1965
(June 21, to August 4, 1965)

	Sample Points					
	CH 43.14 Breakwater Entrance	CR 42.40 Mouth of Calumet R.	CR 41.64 Ewing Ave	CR 39.81 106th St.	CR 37.07 Torrence Ave.	CR 36.01 130th St.
Total Coliform Densities counts/100ml						
Minimum	30	70	430	200	280	120
Maximum	420	1,400	2,600	1,000	4,000	700
Geometric mean	150	363	751	418	680	273
Fecal Streptococcus Densities counts/100ml						
Mininum	<10	<10	<10	<10	20	<10
Maximum	10	230	250	1,600	27,000	800
Geometric mean	<10	24	88	123	345	46

Number of samples at each point was 13

TABLE 40.
AVERAGE DISCHARGES AT T.J.O. O'BRIEN LOCKS FOR DESIGNATED STUDY PERIODS

PERIOD	MEAN DISCHARGE - cfs
June 21 - August 4, 1965	300
Dec., 1965, Jan., Feb., Mar., 1966	180
June - Sept., 1966	325
Apr., May., 1965 & Oct., Nov., 1966	270

Table 41
Frequency Distribution of Average Daily Dissolved Oxygen Levels
Sanitary-Ship Canal at Lemont

	Percentage of Time That Average Daily Dissolved Oxygen Was Equal to or Less Than Stated Value											
Month	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0
Jan. 65		0	5	45	60	60	70	85	95	100		
Feb. 65				0	41	26	63	84	100			
Mar. 65			0	5	25	45	80	90	100			
Apr. 65	0	15	35	45	85	95	100					
May 65	3	50	100									
June 65	19	71	95	100								
July 65	41	91	100									
Aug. 65	50	87	100									
Sep. 65	71	90	100									
Oct. 65	40	70	85	95	100							
Nov. 65		0	12	38	44	56	56	63	94	94	100	
Dec. 65			0	15	20	25	30	30	45	45	88	98
Yearly 1965	22	45	53	62	72	78	84	88	94	95	98	100
Jan. 66				0	53	16	32	58	84	100		
Feb. 66					0	13	20	33	47	67	80	93
Mar. 66	9	13	30	48	57	74	87	96	100			
Apr. 66	5	30	60	85	90	90	90	100				
May 66	10	38	57	76	81	85	85	90	95	100		
June 66	73	82	95	95	100							
July 66	100											
Aug. 66	35	37	83	87	96	100						
Sep. 66	19	38	52	57	81	85	90	95	95	100		
Oct. 66	14	57	67	76	95	100						
Nov. 66	10	20	40	70	90	95	100					
Dec. 66			0	33	57	71	81	81	81	81	81	81
Yearly 1966	24	38	51	64	74	81	85	91	95	98	99	99

Table 42
Frequency Distribution of Average Daily Dissolved Oxygen Levels
Sanitary-Ship Canal at Lockport

Month	Percentage of Time That Average Daily Dissolved Oxygen Was Equal to or Less Than Stated Value									
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0
Jan. 65	0	10	21	38	55	55	69	72	86	93
Feb. 65		0	21	33	38	42	58	63	75	83
Mar. 65	4	32	44	56	72	88	92	100		
Apr. 65	36	68	82	96	96	100				
May 65	32	48	74	87	90	100				
June 65	0	50	73	86	95	100				
July 65	30	70	85	96	96	100				
Aug. 65	36	84	90	97	100					
Sep. 65	76	97	100							
Oct. 65	18	47	100							
Nov. 65	0	3	10	30	53	63	72	87	100	
Dec. 65			0	10	19	26	32	39	84	97
Yearly 65	19	42	58	69	76	81	85	88	95	97
Jan. 66			0	10	19	38	67	86	100	
Feb. 66		0	5	10	33	71	86	95	95	100
Mar. 66	37	53	63	74	90	100				
Apr. 66	33	64	87	97	97	100				
May 66	42	68	77	77	84	90	94	94	100	
June 66	60	83	90	93	97	100				
July 66	94	97	100							
Aug. 66	42	61	77	84	90	100				
Sep. 66	32	56	80	84	88	96	100			
Oct. 66	28	59	66	79	93	100				
Nov. 66	17	31	55	90	100					
Dec. 66		0	21	52	66	69	79	79	79	83
Yearly 66	32	48	60	69	80	89	94	96	98	99

Table 43
Summary of Physical and Chemical Water Quality
Sanitary and Ship Canal at Lemont

Date		Temp. °C	D.O.	pH	Total Alk. as CaCO$_3$	BOD	COD	Total N	Suspended Solids Tot.	Suspended Solids Org.	Suspended Solids Inorg.	Turb. JCU	Spec. Cond.	Tot. Dis. Sol.	Cl.
Jan.	65	7.9	2.8												
Feb.	65	7.0	3.3	7.5	180	5.6	-	-	51	-	-	38	850	489	-
Mar.	65	8.4	3.1	7.3	189	7.6	-	-	52	-	-	52	1089×	684	-
Apr.	65	12.9	1.9	7.2	212	7.1	-	-	57	-	-	58	929	783	85
May	65	19.5	0.7	7.2	210	7.8	-	-	36	-	-	34	830	584	73
June	65	21.7	0.8	7.2	187	6.8	-	-	26	-	-	28	686	513	58
July	65	25.1	0.7	7.2	207	7.2	-	-	41	-	-	31	685	473	59
Aug.	65	23.2	0.7	7.3	183	5.9	-	-	28	-	-	30	635	379	48
Sep.	65	18.1	0.5	7.2	212	5.8	-	-	32	-	-	30	727	489	51
Oct.	65	18.5	0.9	7.3	208	4.6	-	-	22	-	-	29	769	462	54
Nov.	65	14.2	3.0	7.4	193	5.1	-	-	24	-	-	27	735	477	59
Dec.	65	7.8	4.6	7.5	206	5.8	-	-	46	-	-	40	742	506	58
Avg.	65	15.3	1.9	7.3	199	6.3	-	-	38	-	-	36	788	528	61
Jan.	66	6	3.8	7.5	224	5.7	49.9	9.2	33	-	-	33	943	659	90
Feb.	66	7	4.7	7.4	218	7.8	59.0	8.2	37	-	-	45	891	626	93
Mar.	66	11	2.3	7.3	224	7.7	37.2	7.5	18	15	13	52	887	637	97
Apr.	66	16	1.6	7.3	202	7.8	46.7	7.1	49	32	17	46	816	543	94
May	66	18	1.7	7.3	198	7.8	37.0	6.1	54	38	16	56	827	589	87
June	66	25.7	0.5	7.3	201	9.4	36.8	7.0	20	10	10	34	841	564	87
July	66	28.0	0.4	7.1	150	7.5	-	8.0	22	15	7	25	700	378	65
Aug.	66	26.9	1.0	7.3	140	4.4	26.1	5.7	26	15	11	25	588	383	66
Sep.	66	24.3	1.9	7.3	141	4.0	30.2	5.8	25	15	10	25	563	390	58
Oct.	66	18.7	1.3	7.2	147	5.7	31.4	7.6	31	23	8	25	647	404	64
Nov.	66	17.8	1.7	7.3	135	5.4	35.0	8.0	20	10	11	27	636	427	68
Dec.	66	10	3.7	7.2	155	4.7	37	6.9	43	31	11	37	737	499	74
Avg.	66	17.5	2.1	7.3	178	6.5	41.9	7.3	32	20.4	11.4	36	756	508	78

Results expressed as mg/l, except where indicated.

Table 44
Summary of Physical and Chemical Water Quality
Sanitary and Ship Canal at Lockport

Date	Temp. °C	D.O. mg/l	pH	Total Alk. as $CaCO_3$	BOD mg/l	COD mg/l	Suspended Solids			Total N mg/l	Turb. JCU	Spec. Cond. umhos	Tot. Dis. Sol. mg/l	Cl mg/l
							Tot.	Org.	Inorg.					
Jan. 65	11.7	2.9	7.5	193	10.3	-	-	-	-	-	34	781	-	-
Feb. 65	9.8	3.3	-	-	10.2	-	-	-	-	-	-	-	-	-
Mar. 65	10.2	1.8	7.4	165	4.5	-	18	-	-	-	34	1165	655	-
Apr. 65	16.3	0.8	7.6	190	7.2	-	43	-	-	-	55	895	772	81
May 65	22.7	1.1	7.7	180	11.1	-	32	-	-	-	32	825	579	76
June 65	26.2	1.2	7.6	165	13.1	-	28	-	-	-	27	655	500	63
July 65	28.2	0.8	7.5	177	12.8	-	19	-	-	-	27	675	473	61
Aug. 65	26.4	0.6	7.5	155	11.2	-	27	-	-	-	28	615	389	50
Sept. 65	23.8	0.4	7.4	170	12.4	-	31	-	-	-	31	700	535	52
Oct. 65	22.1	0.9	7.5	174	7.4	-	19	-	-	-	26	728	499	62
Nov. 65	17.0	2.6	7.5	156	9.4	-	18	-	-	-	26	688	521	58
Dec. 65	14.0	3.9	7.7	170	11.4	-	80	-	-	-	48	723	534	62
Avg. 65	19.0	1.7	7.5	172	10.1	-	32	-	-	-	33	768	546	63
Jan. 66	13	3.1	7.7	190	12	48	29	-	-	8.6	30	888	695	96
Feb. 66	13	2.7	7.5	188	8.1	51	33	-	-	9.1	41	880	602	102
Mar. 66	14.4	1.2	7.4	178	9	36	37	16	11	7.0	50	868	613	95
Apr. 66	16.2	0.8	7.4	179	11.4	35	28	15	13	7.0	43	820	609	96
May 66	20	1.1	7.3	170	12	35	34	22	12	7.5	59	819	615	91
June 66	27.2	0.6	7.3	173	13	33	14	7	8	6.5	29	820	594	86
July 66	30.4	0.2	7.3	164	15	36	20	11	9	7.5	30	645	492	68
Aug. 66	27.3	1.0	7.3	122	14.2	28	20	10	10	8.1	25	578	468	65
Sept. 66	26	1.1	7.3	127	9.4	28	14	8	6	6.3	25	559	434	56
Oct. 66	21.3	1.1	7.2	128	11	28	24	15	9	7.5	25	670	399	68
Nov. 66	16.3	1.3	7.2	118	7.4	30	16	9	7	7.5	25	618	434	68
Dec. 66	13	3.2	7.1	132	9	28	20	12	9	6.3	25	734	496	74
Avg. 66	19.8	1.5	7.3	156	11.0	35	24	12.5	9.4	7.3	34	741	538	80

Table 45
Frequency Distribution of Average Daily Dissolved Oxygen Levels
Des Plaines River at Lemont

	Percentage of Time That Daily Dissolved Oxygen Was Equal to or Less Than Stated Value											
Month	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**	**7.0**	**8.0**	**9.0**	**10.0**	**11.0**	**12.0**	**13.0**
Jan. 65(1)								0	22	67	100	
Feb. 65(2)								0	43	100		
Mar. 65							0	9	68	91	100	
Apr. 65						0	30	80	100			
May 65	0	5	35	65	75	85	100					
June 65	0	5	60	65	70	85	95	100				
July 65	0	5	10	14	33	43	48	90	100			
Aug. 65	0	9	41	50	55	59	68	82	95	100		
Sep. 65		0	38	81	86	100						
Oct. 65			0	10	25	50	70	100				
Nov. 65						0	6	56	81	94	100	
Dec. 65							0	12	18	30	35	88
Yearly 65	0	2	16	27	32	40	49	68	83	92	95	100
Jan. 66										0	40	100
Feb. 66							0	12	12	37	88	100
Mar. 66						0	4	9	26	56	100	
Apr. 66				0	5	20	40	40	-	-	50	70
May 66		0	5	10	19	33	43	71	86	95	100	
June 66	0	5	59	73	73	82	82	87	-	-	91	100
July 66	0	10	20	40	50	65	75	80	85	95	100	
Aug. 66		0	9	26	30	48	52	70	91	100		
Sep. 66						0	24	33	57	81	90	100
Oct. 66		0	5	15	15	20	25	25	30	50	70	90
Nov. 66		0	5	10	15	15	30	55	65	80	90	100
Dec. 66						0	6	18	38	82	100	
Yearly 66	0	1	10	16	19	27	35	46	57	72	86	96

(1) Jan. 65 only 9 obs.; Feb. 65 only 7 obs.; due to frozen river conditions.
(2) Jan. 66 only 10 obs.; Feb. 66 only 8 obs.; due to frozen river conditions.

Table 46
Summary of Physical and Chemical Water Quality
Des Plaines River at Lemont Rd.

Date		Temp. °C	D.O.	pH	Alk. $CaCO_3$	BOD	COD	Total N	Suspended Solids			Turb. JCU	Spec. Cond. umhos	Tot. Dis. Sol.	Cl^-
									Tot.	Org.	Inorg.				
Jan.	65	1.6	10.7	7.7	213	5.4	-	-	66	-	-	73	858	579	-
Feb.	65	1.2	10.1	7.9	160	4.4	-	-	41	-	-	30	623	361	-
Mar.	65	1.4	9.4	7.8	191	4.2	-	-	47	-	-	65	909	675	-
Apr.	65	8.5	8.7	7.7	200	5.6	-	-	99	-	-	81	682	658	53
May	65	17.7	5.3	7.7	248	6.7	-	-	92	-	-	76	876	616	67
June	65	20.6	5.4	7.8	247	7.8	-	-	111	-	-	78	927	726	80
July	65	23.1	6.1	8.0	253	9.3	-	-	132	-	-	84	953	690	87
Aug.	65	21.1	6.4	7.7	231	9.3	-	-	134	-	-	61	848	594	85
Sep.	65	15.4	4.9	7.6	271	4.3	-	-	81	-	-	56	832	662	60
Oct.	65	13.3	7.0	7.9	292	5.3	-	-	87	-	-	47	928	688	71
Nov.	65	7.6	9.5	8.0	252	4.6	-	-	53	-	-	42	753	678	61
Dec.	65	1.1	11.0	8.3	286	3.9	-	-	34	-	-	45	838	647	72
Avg.	65	11.0	7.9	7.8	237	5.9	-	-	81	-	-	62	836	631	71
Jan.	66	0.0	12.3	8.4	260	3.3	30.6	-	30	-	-	34	785	648	58
Feb.	66	0.0	11.1	8.1	211	6.8	36.8	3.7	63	-	-	62	766	512	101
Mar.	66	4.0	10.6	8.0	248	4.2	29.6	2.1	52	31	20	54	849	657	84
Apr.	66	11.0	11.3	8.1	199	6.3	38.8	2.5	57	39	18	66	691	583	69
May	66	16.0	7.9	7.8	217	5.1	31.7	2.0	85	68	17	76	733	547	80
June	66	23.3	3.9	7.8	242	7.6	30.2	2.5	106	78	28	107	866	702	75
July	66	28.2	6.4	8.0	250	9.4	51.8	2.8	145	107	38	142	997	874	99
Aug.	66	24.2	7.3	8.1	181	11.0	52.1	3.1	114	85	29	134	917	776	86
Sep.	66	20.3	9.4	8.6	219	9.8	54.2	3.5	64	41	23	81	1169	893	130
Oct.	66	10.0	10.3	8.3	201	10.2	53.1	2.8	68	44	24	102	1006	779	118
Nov.	66	8.0	9.0	7.9	184	7.1	37.0	3.2	43	22	22	60	873	673	95
Dec.	66	3.0	10.1	7.9	190	5.0	31.0	3.3	30	20	9	35	1011	766	109
Avg.	66	12.3	9.1	8.1	217	7.2	39.7	2.9	71	53.5	22.8	79	888	701	92

Results expressed as mg/l, except where indicated

APPENDIX B

Figures 1 through 92

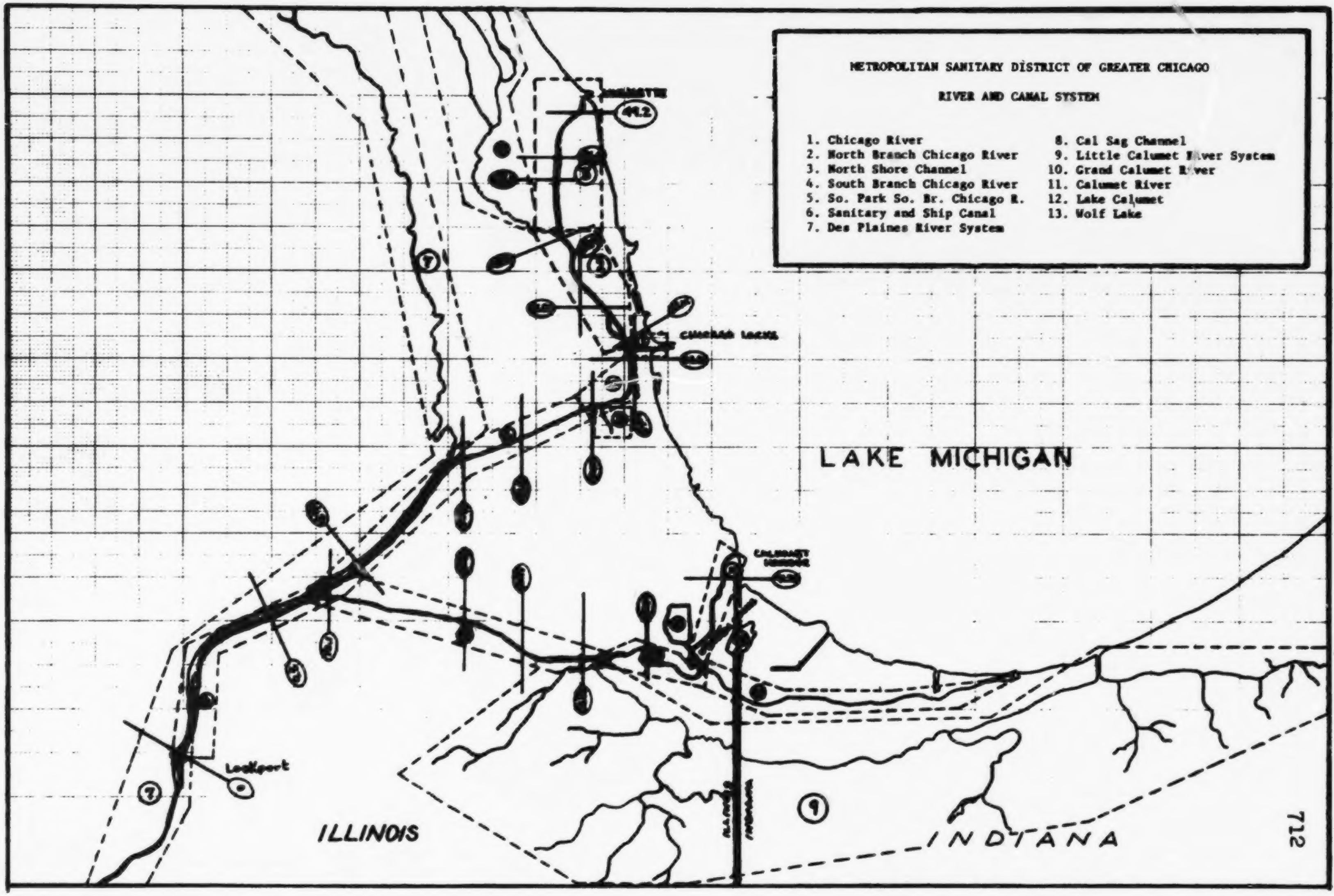

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RIVER AND CANAL SYSTEM
1. Chicago River
2. North Branch Chicago River
3. North Shore Channel
4. South Branch Chicago River
5. So. Park So. Br. Chicago R.
6. Sanitary and Ship Canal
7. Des Plaines River System
8. Cal Sag Channel
9. Little Calumet River System
10. Grand Calumet River
11. Calumet River
12. Lake Calumet
13. Wolf Lake
LAKE MICHIGAN
ILLINOIS
INDIANA
Lockport
49.2
CHICAGO LOCKS
712

Figure 1.

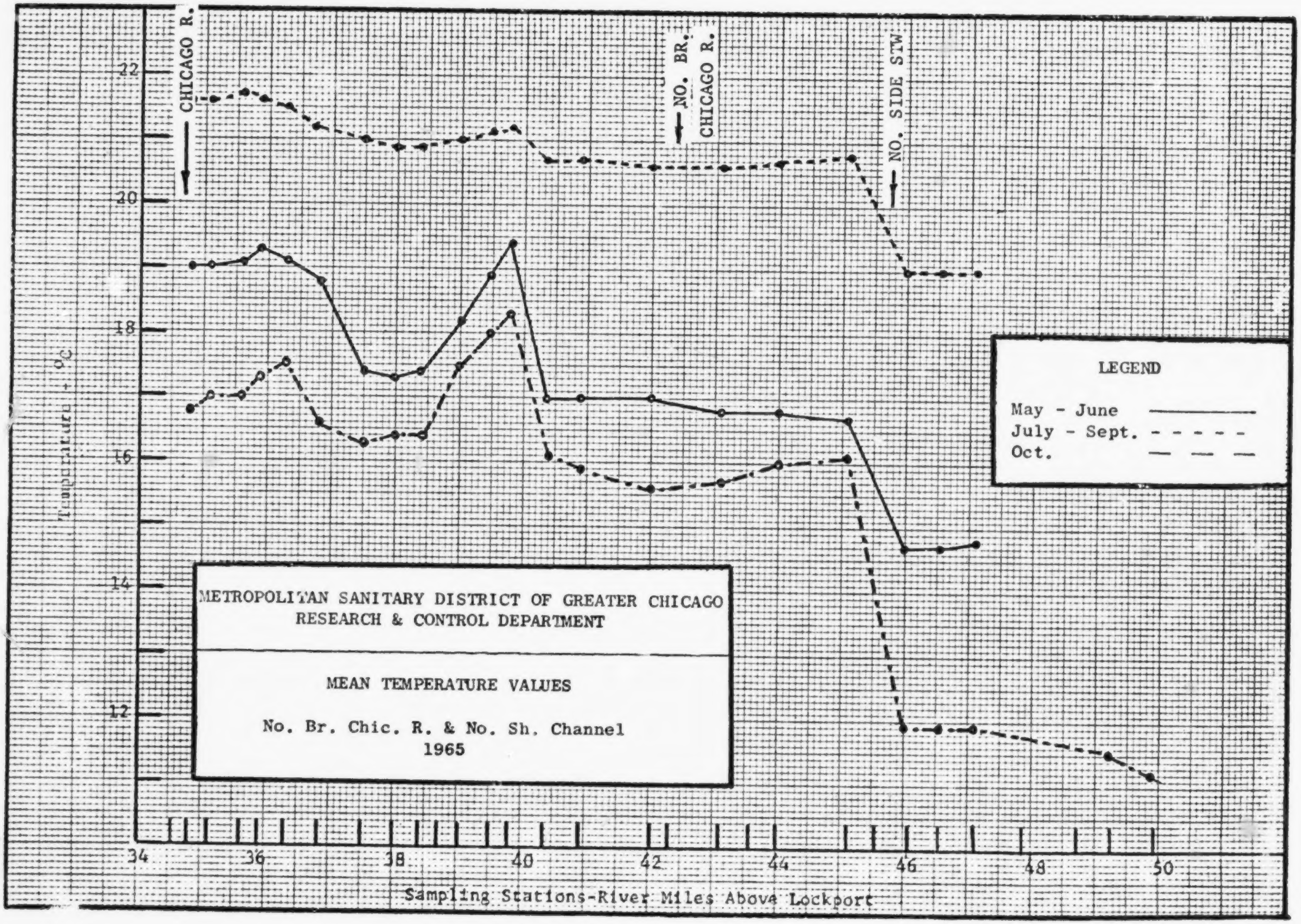

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN TEMPERATURE VALUES
No. Br. Chic. R. & No. Sh. Channel
1965
LEGEND
May - June
July - Sept.
Oct.
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
Temperature - °C
12
14
16
18
20
22
34
36
38
40
42
44
46
48
50
Sampling Stations-River Miles Above Lockport

Figure 2.

NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

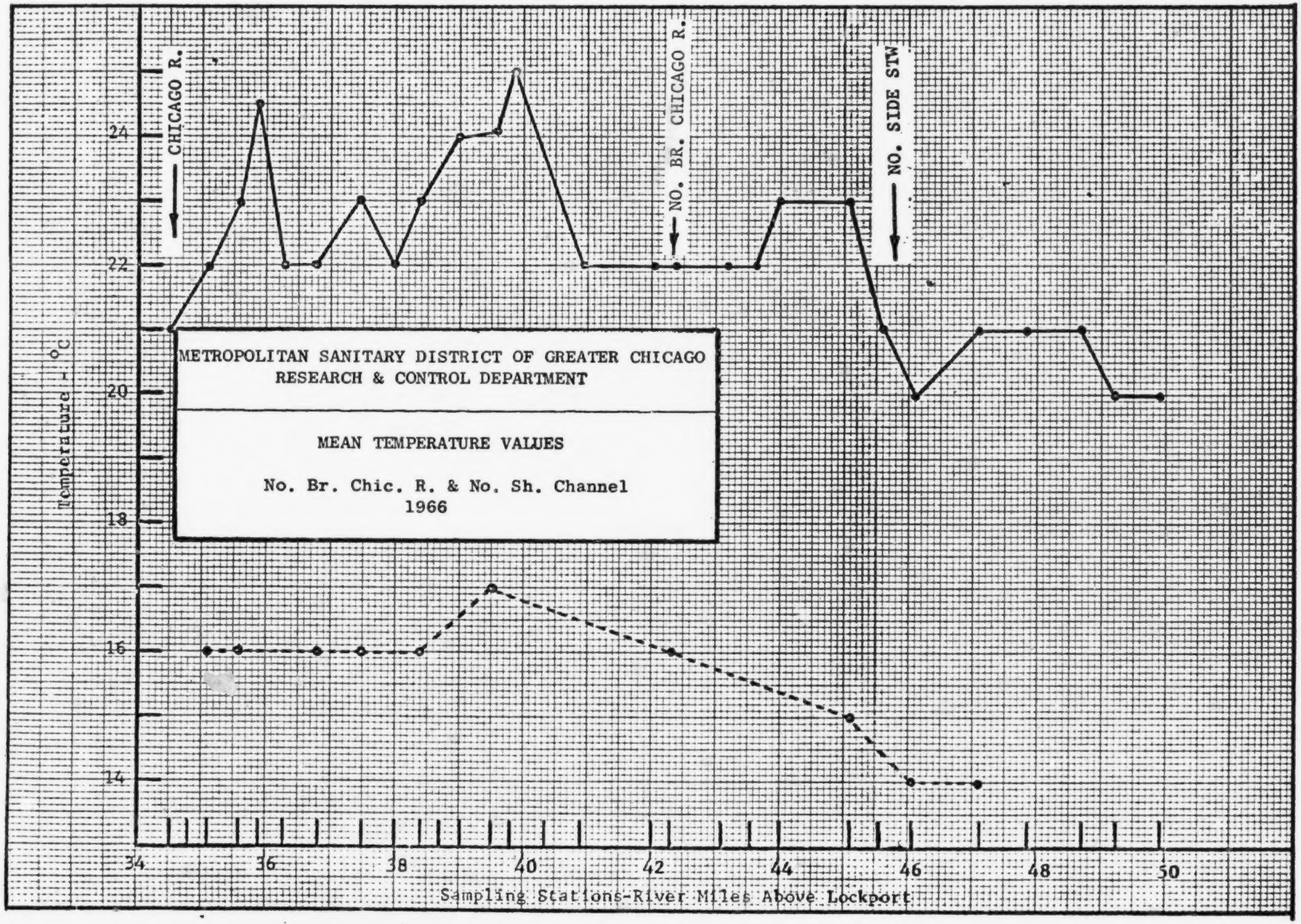
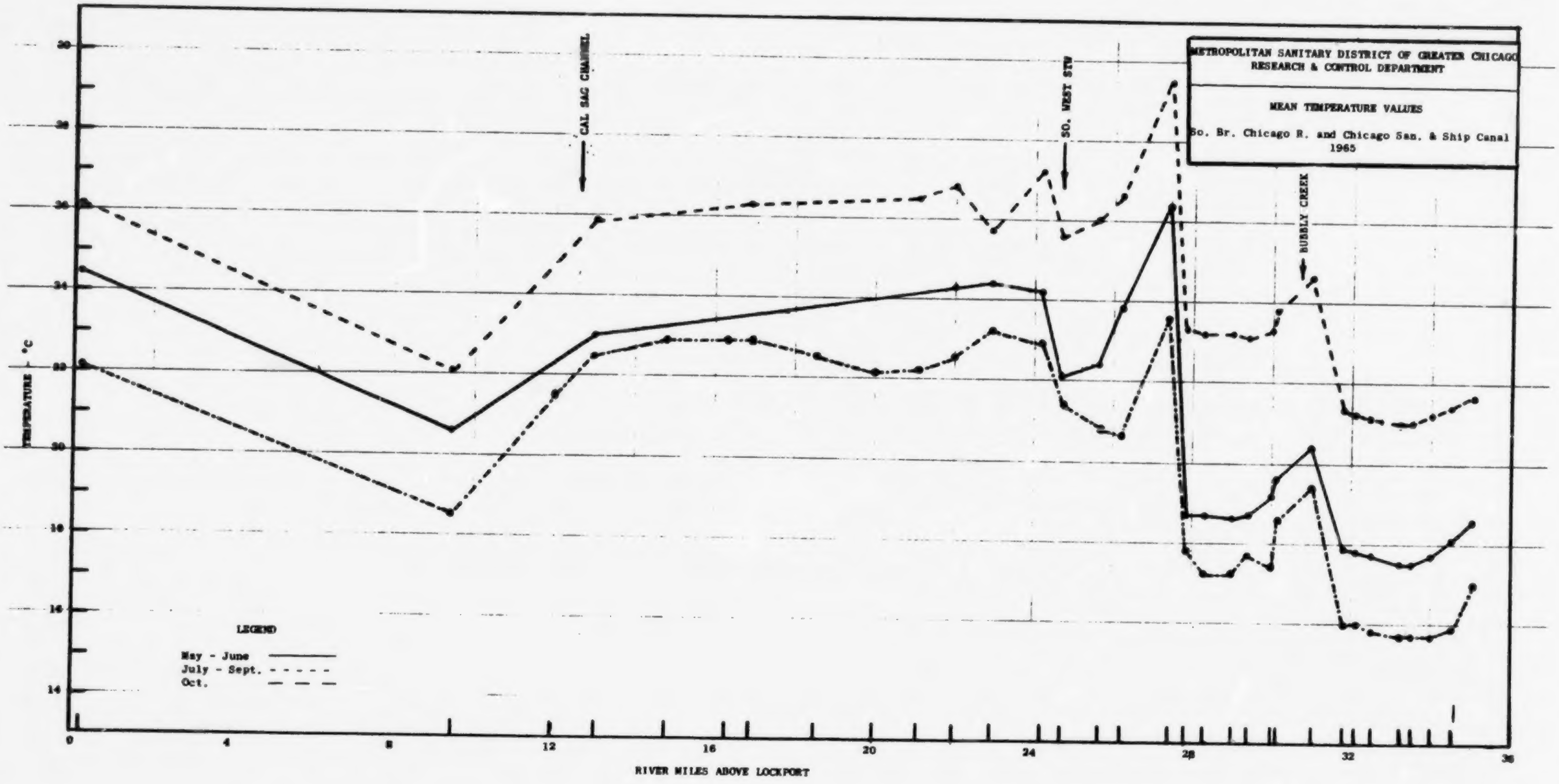


Figure 3



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT

MEAN TEMPERATURE VALUES

So. Br. Chicago R. and Chicago San. & Ship Canal
1965

Figure 4.

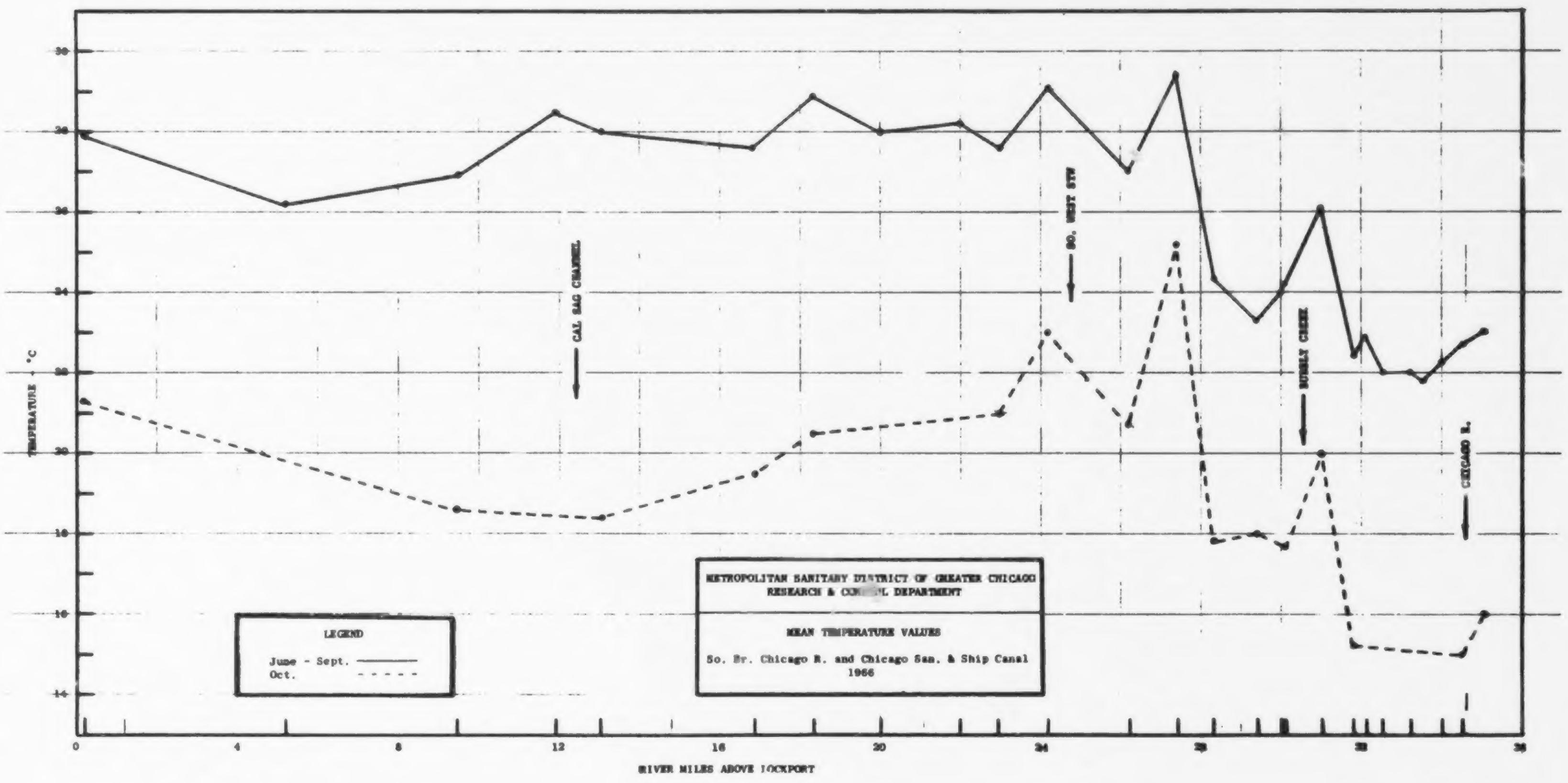

TEMPERATURE - °C
30
28
26
24
22
20
18
16
14
0
4
8
12
16
20
24
28
32
36
RIVER MILES ABOVE LOCKPORT
CAL SAG CHANNEL
SO. WEST STW
BUBBLY CREEK
CHICAGO R.
LEGEND
June - Sept.
Oct.
METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN TEMPERATURE VALUES
So. Br. Chicago R. and Chicago San. & Ship Canal
1966

Figure 5.

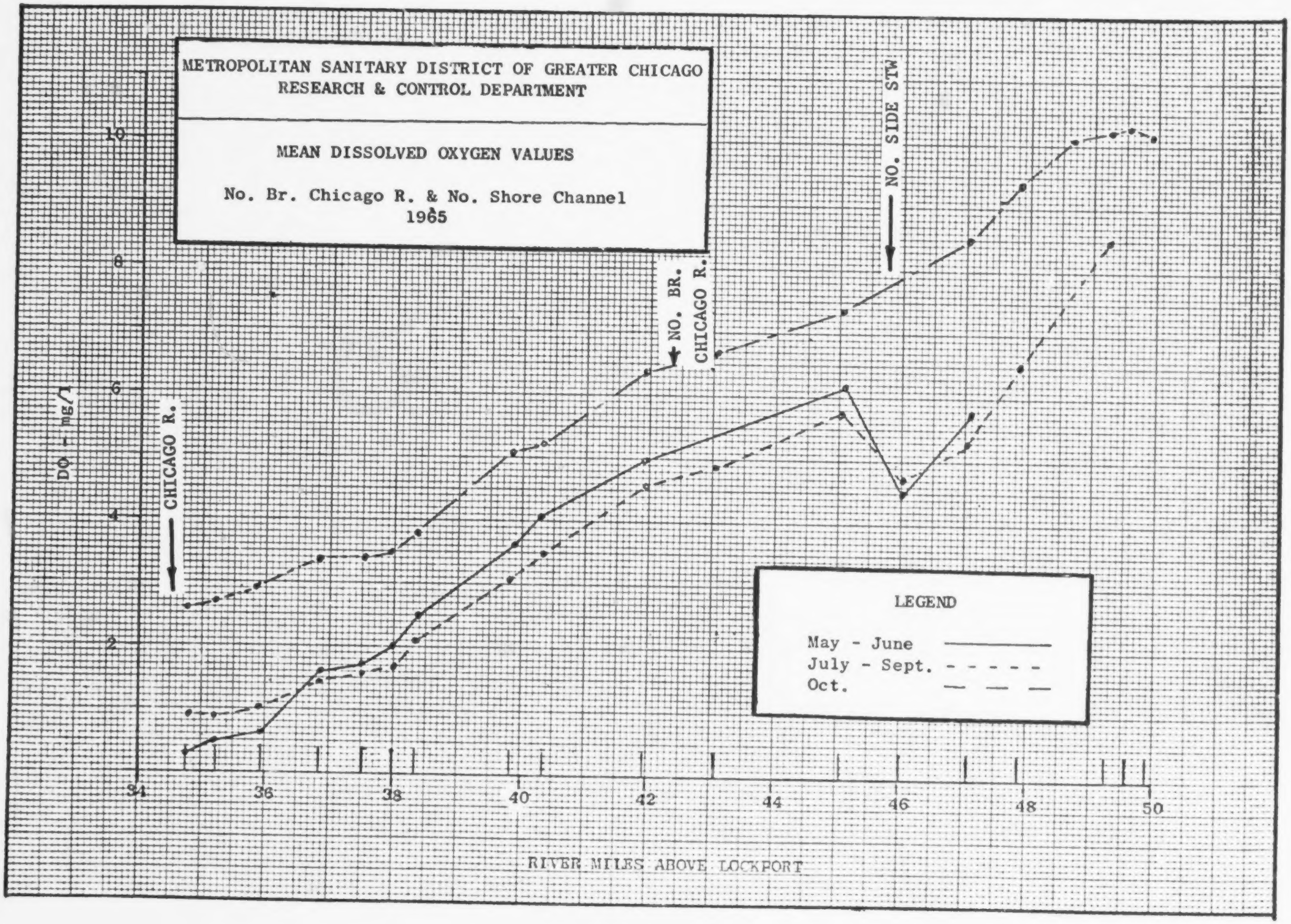
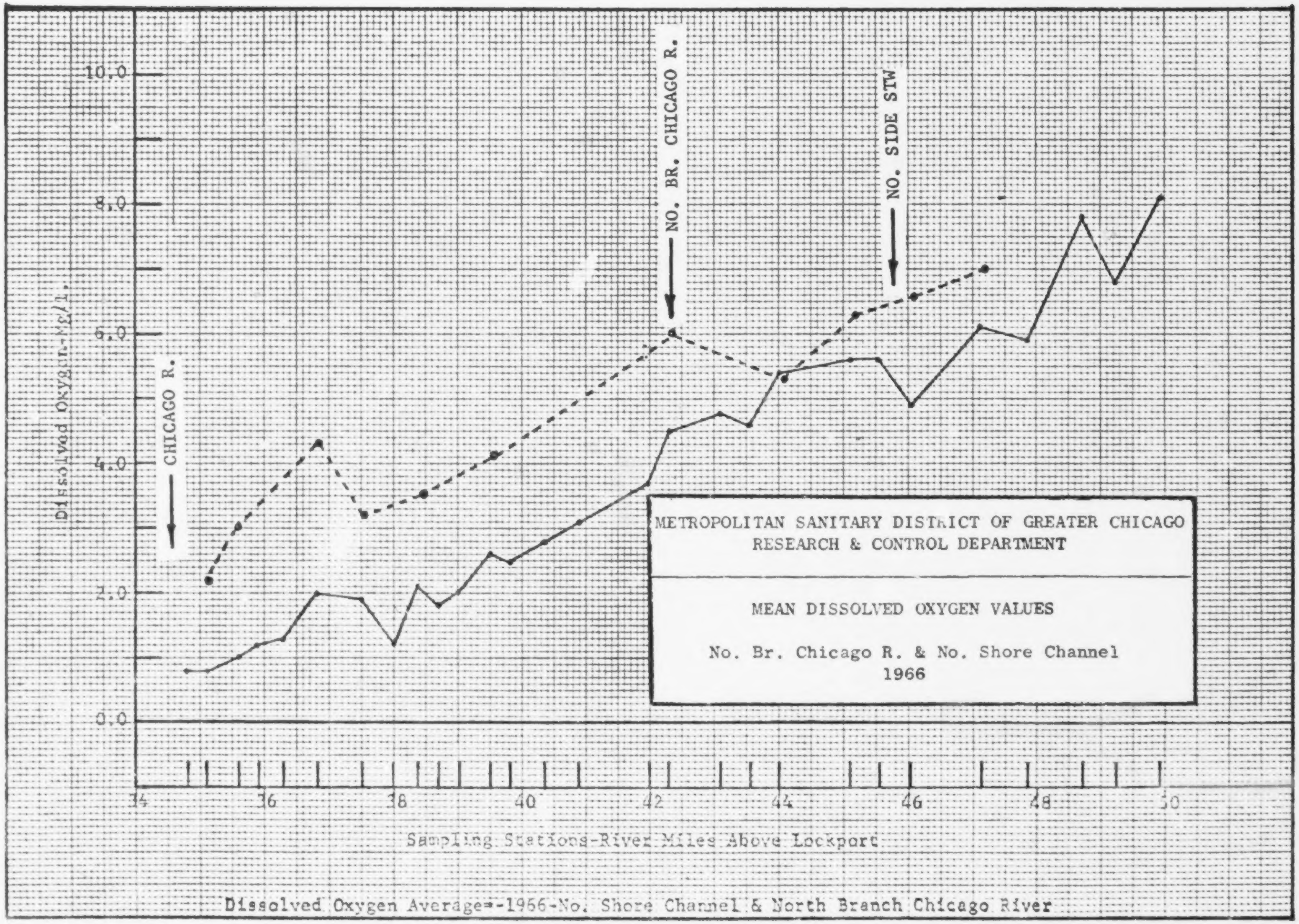

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN DISSOLVED OXYGEN VALUES
No. Br. Chicago R. & No. Shore Channel
1965
DO - mg/l
10
8
6
4
2
34
36
38
40
42
44
46
48
50
RIVER MILES ABOVE LOCKPORT
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
LEGEND
May - June
July - Sept.
Oct.

Figure 6.



Dissolved Oxygen Average=-1966-No. Shore Channel & North Branch Chicago River

Figure 7.

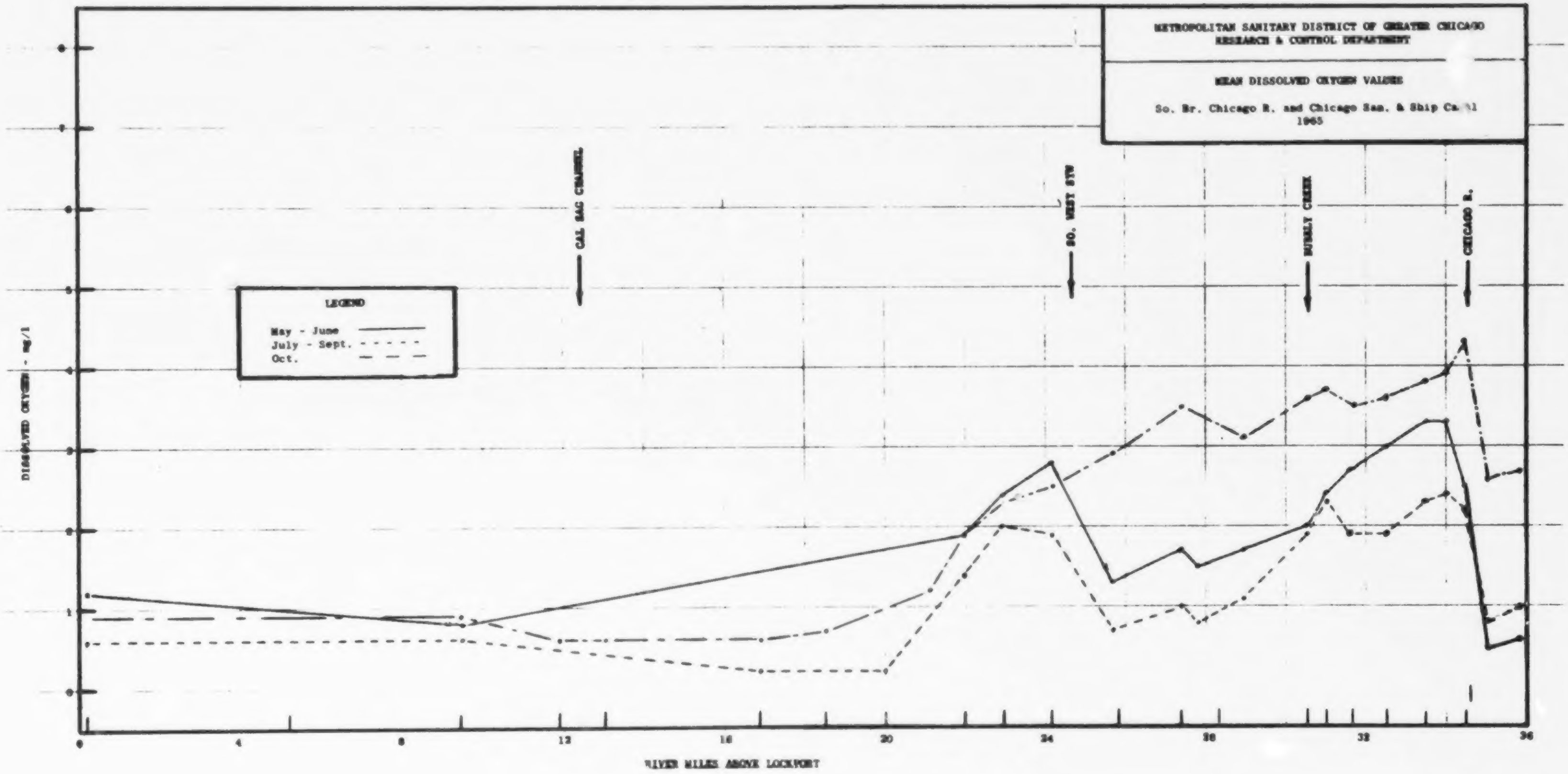
METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN DISSOLVED OXYGEN VALUES
So. Br. Chicago R. and Chicago San. & Ship Canal
1965
LEGEND
May - June
July - Sept.
Oct.
CAL SAC CHANNEL
SO. WEST STW
BUBBLY CREEK
CHICAGO R.
DISSOLVED OXYGEN - mg/l
0
1
2
3
4
5
6
7
8
0
4
8
12
16
20
24
28
32
36
RIVER MILES ABOVE LOCKPORT

Figure 8.

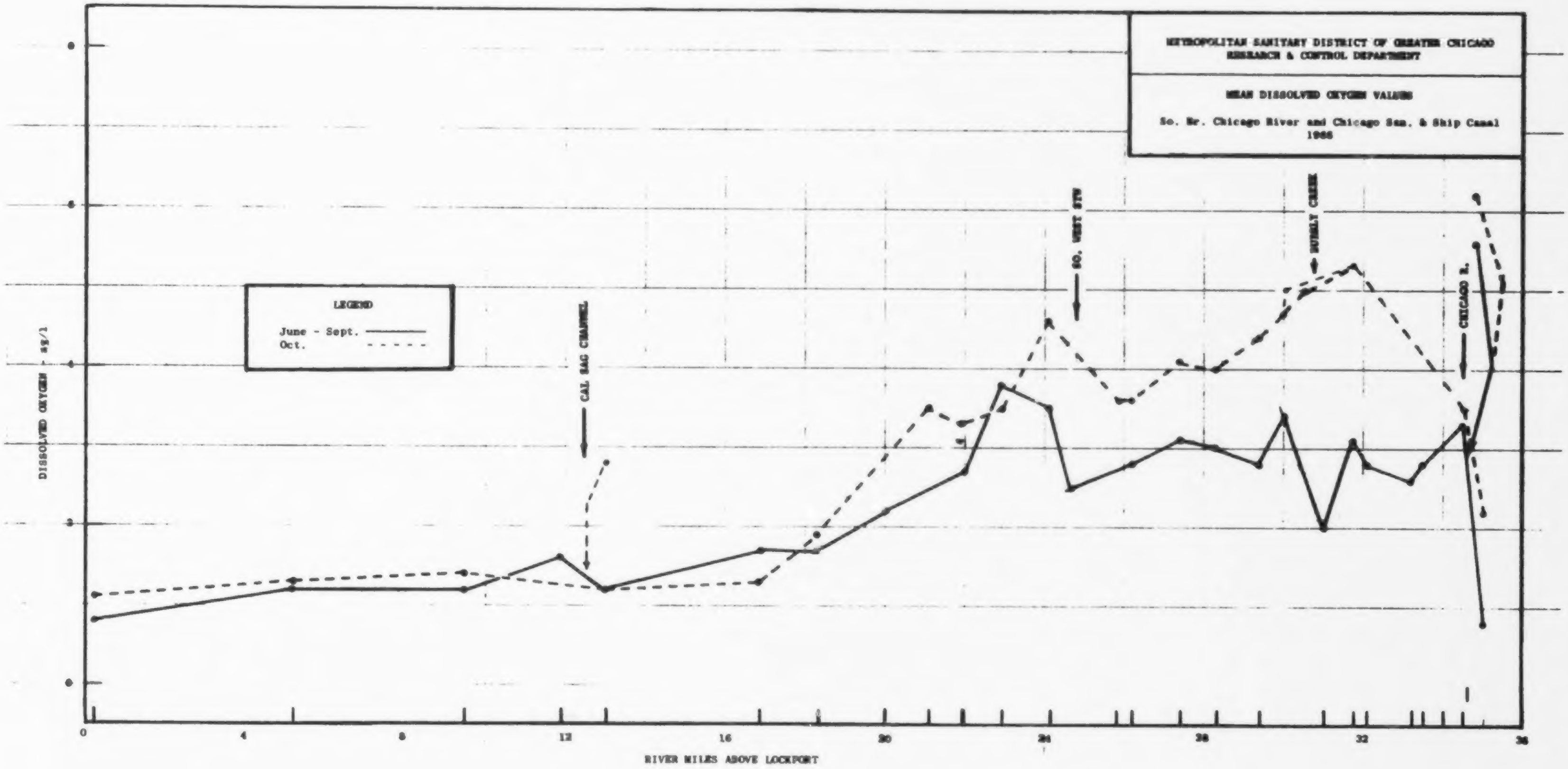
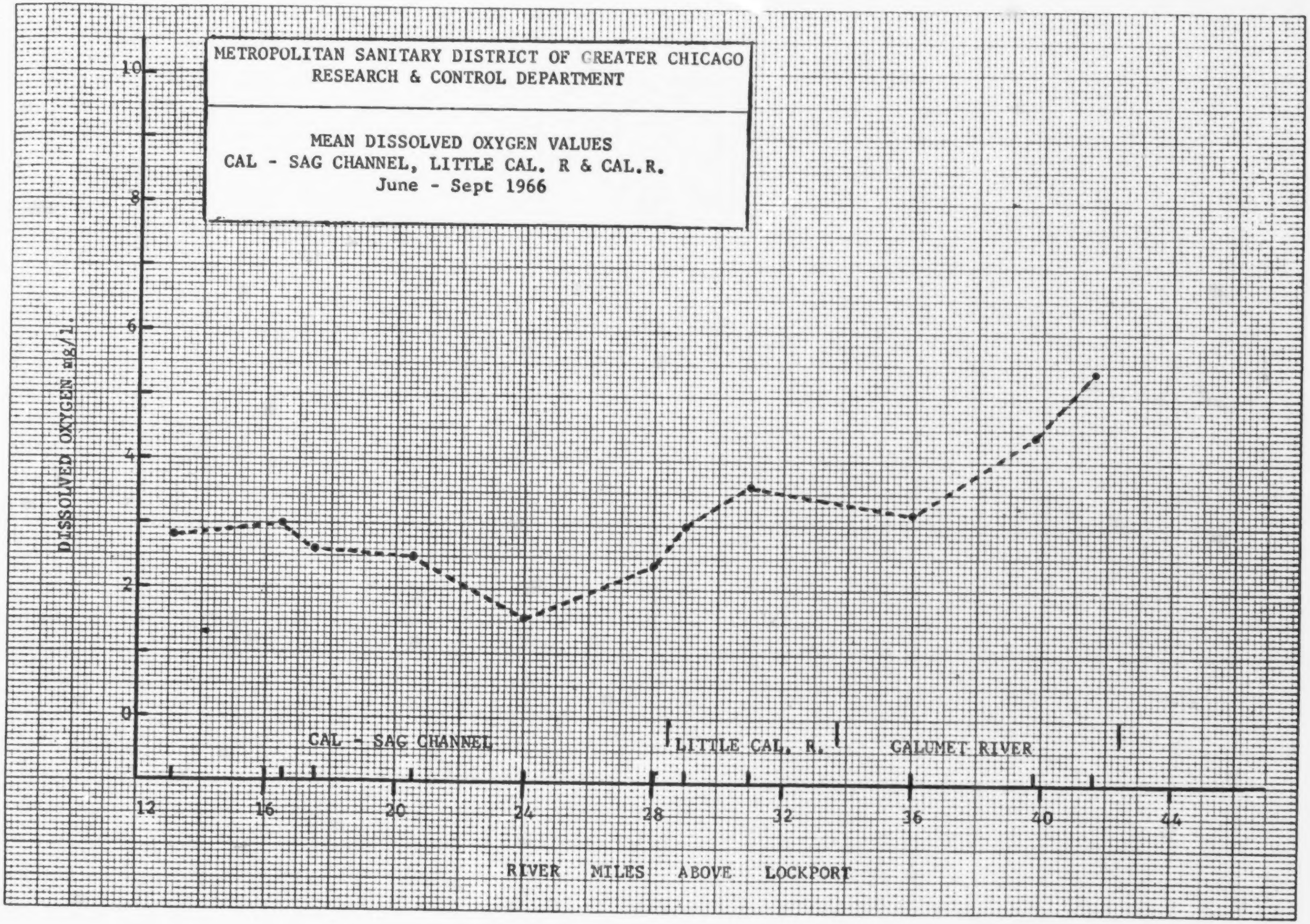

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN DISSOLVED OXYGEN VALUES
So. Br. Chicago River and Chicago San. & Ship Canal
1966
LEGEND
June - Sept.
Oct.
CAL SAG CHANNEL
SO. WEST STW
BUBBLY CREEK
CHICAGO R.
DISSOLVED OXYGEN - mg/l
0
4
8
12
16
20
24
28
32
36
RIVER MILES ABOVE LOCKPORT

Figure 9.

NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT

MEAN DISSOLVED OXYGEN VALUES
CAL - SAG CHANNEL, LITTLE CAL. R & CAL.R.
June - Sept 1966

Figure 10.

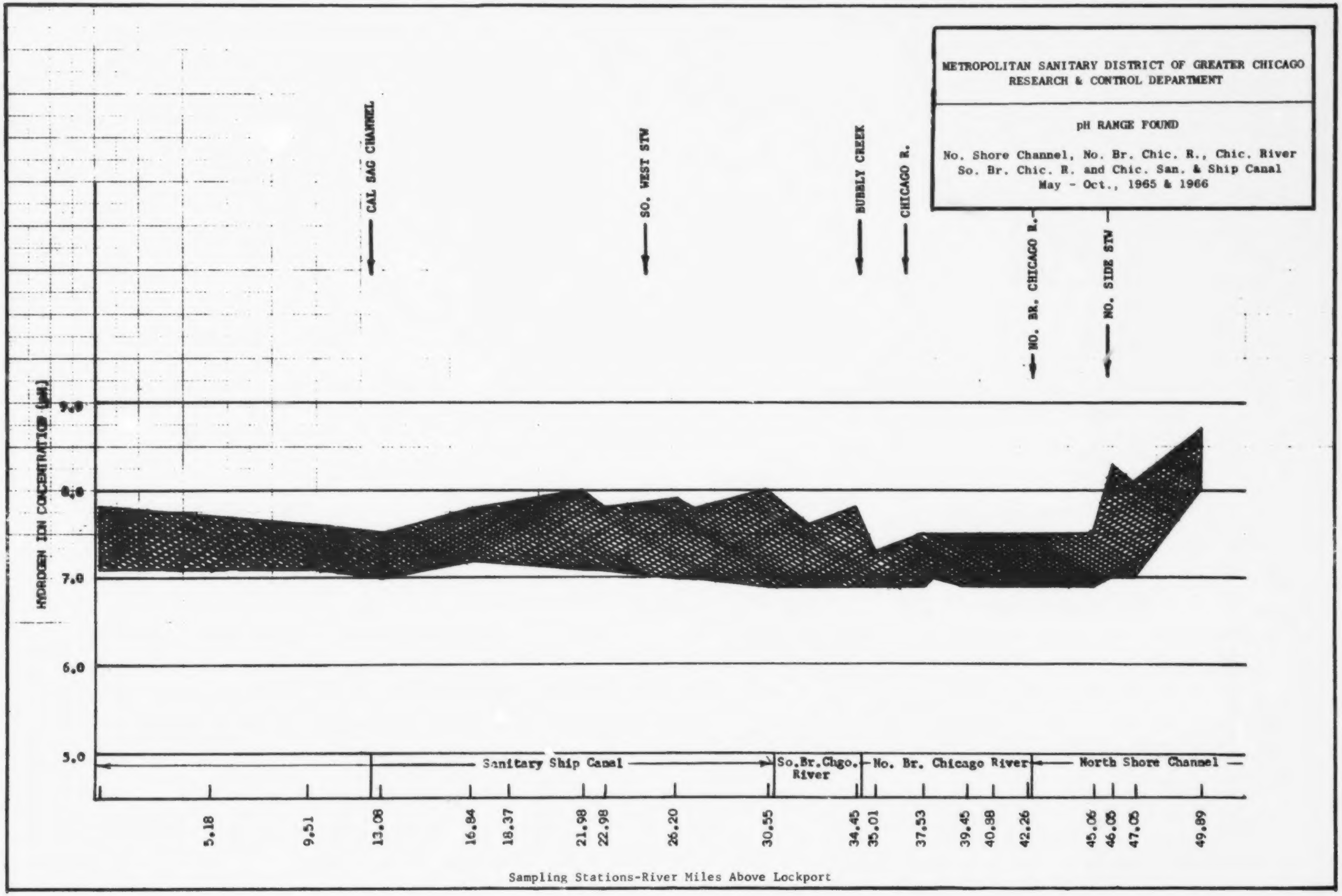

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
pH RANGE FOUND
No. Shore Channel, No. Br. Chic. R., Chic. River
So. Br. Chic. R. and Chic. San. & Ship Canal
May - Oct., 1965 & 1966
CAL SAG CHANNEL
SO. WEST STW
BUBBLY CREEK
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
HYDROGEN ION CONCENTRATION (pH)
9.0
8.0
7.0
6.0
5.0
Sanitary Ship Canal
So.Br.Chgo. River
No. Br. Chicago River
North Shore Channel
5.18
9.51
13.08
16.84
18.37
21.98
22.98
26.20
30.55
34.45
35.01
37.53
39.45
40.88
42.26
45.06
46.05
47.05
49.89
Sampling Stations-River Miles Above Lockport

Figure 11.

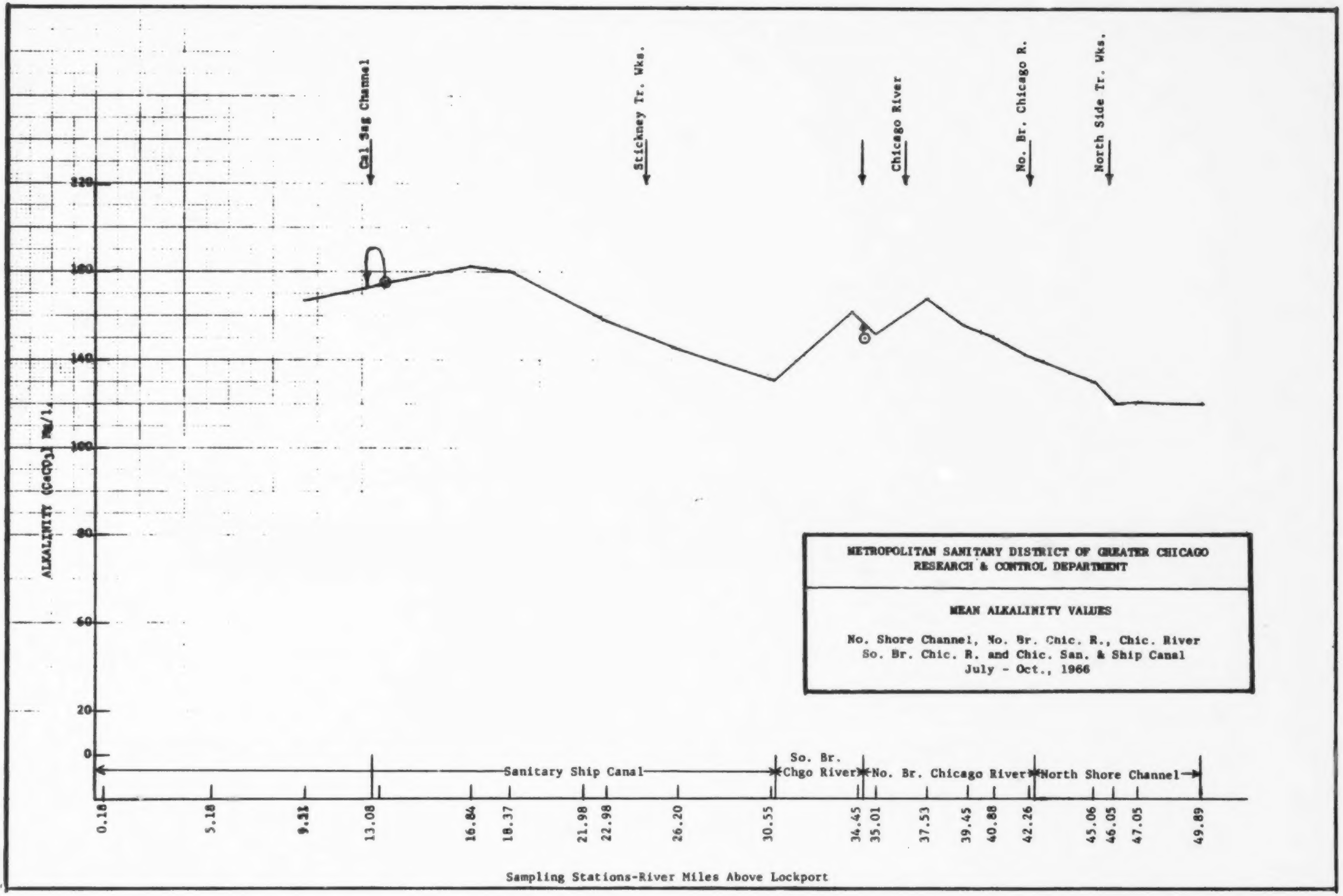

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN ALKALINITY VALUES
No. Shore Channel, No. Br. Chic. R., Chic. River
So. Br. Chic. R. and Chic. San. & Ship Canal
July - Oct., 1966
Cal Sag Channel
Stickney Tr. Wks.
Chicago River
No. Br. Chicago R.
North Side Tr. Wks.
ALKALINITY (CaCO3) Mg/l.
120
160
140
100
80
60
20
0
Sanitary Ship Canal
So. Br. Chgo River
No. Br. Chicago River
North Shore Channel
0.18
5.18
9.31
13.08
16.84
18.37
21.98
22.98
26.20
30.55
34.45
35.01
37.53
39.45
40.88
42.26
45.06
46.05
47.05
49.89
Sampling Stations-River Miles Above Lockport

Figure 12.

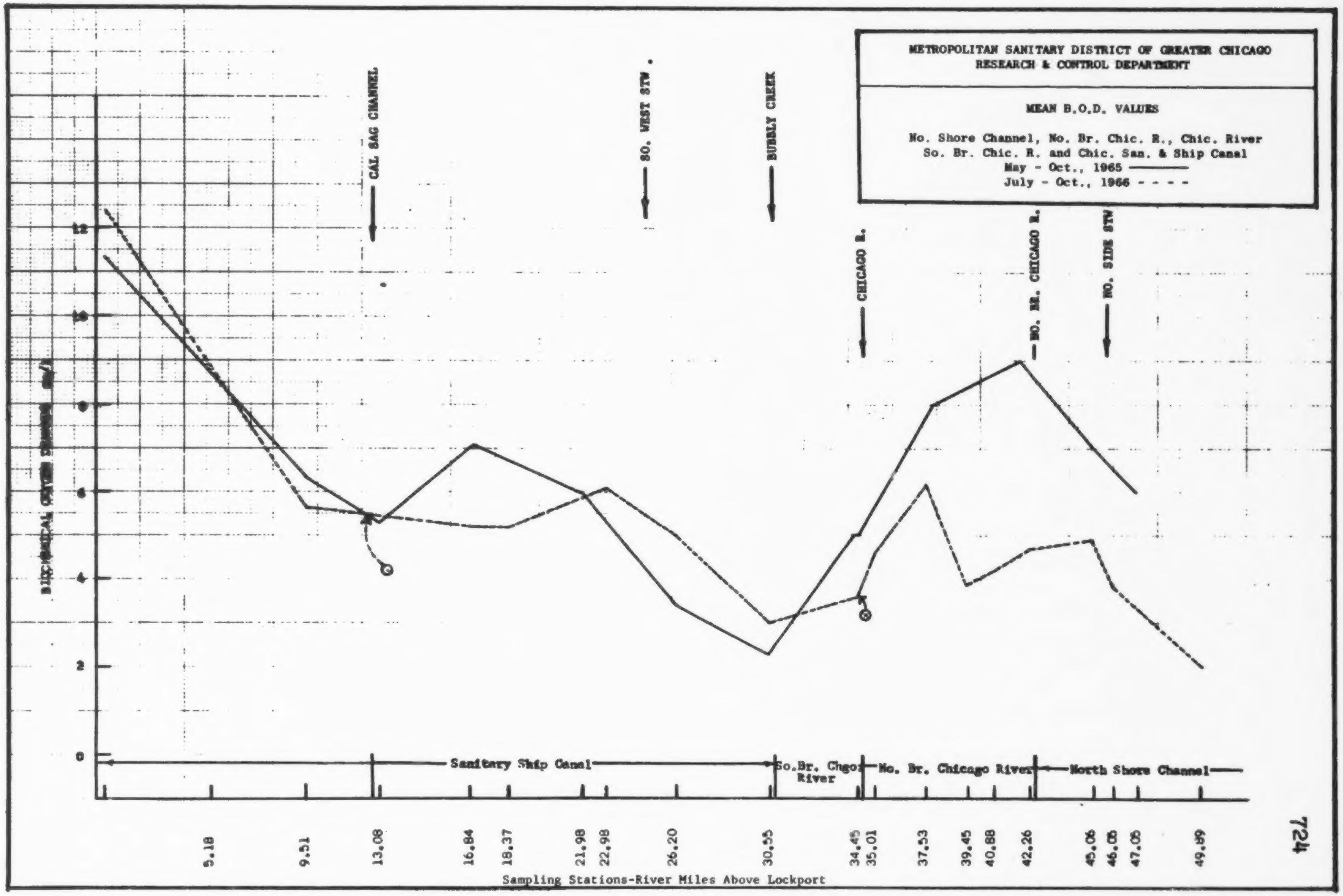

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN B.O.D. VALUES
No. Shore Channel, No. Br. Chic. R., Chic. River
So. Br. Chic. R. and Chic. San. & Ship Canal
May - Oct., 1965 ———
July - Oct., 1966 - - - -
CAL SAG CHANNEL
SO. WEST STW
BUBBLY CREEK
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
BIOCHEMICAL OXYGEN DEMAND mg/l
0
2
4
6
8
10
12
Sanitary Ship Canal
So.Br. Chgo River
No. Br. Chicago River
North Shore Channel
5.18
9.51
13.08
16.84
18.37
21.98
22.98
26.20
30.55
34.45
35.01
37.53
39.45
40.88
42.26
45.06
46.08
47.05
49.89
Sampling Stations-River Miles Above Lockport

Figure 13.

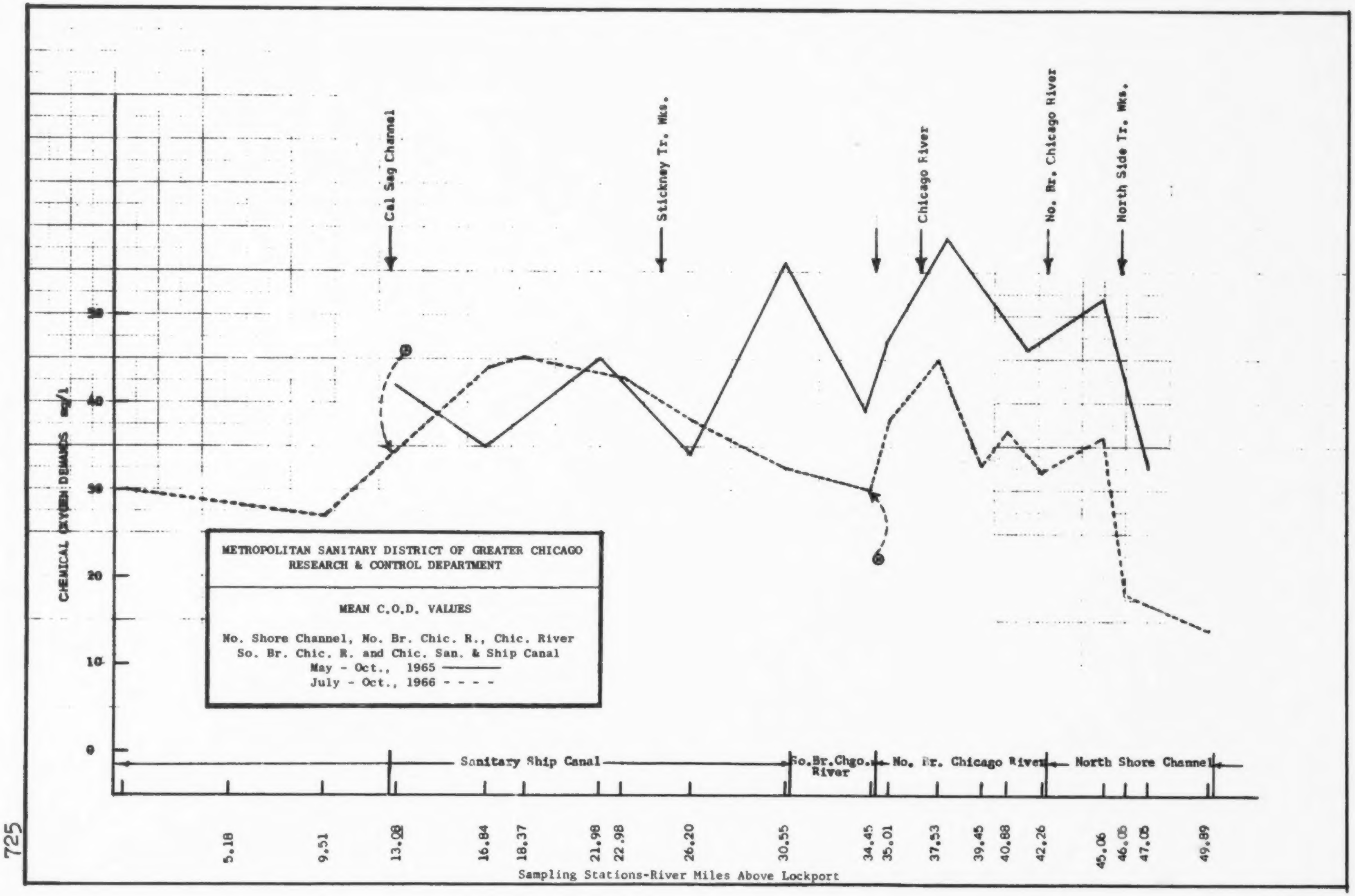

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN C.O.D. VALUES
No. Shore Channel, No. Br. Chic. R., Chic. River
So. Br. Chic. R. and Chic. San. & Ship Canal
May - Oct., 1965 ———
July - Oct., 1966 - - - -
CHEMICAL OXYGEN DEMANDS mg/1
0
10
20
30
40
50
Cal Sag Channel
Stickney Tr. Wks.
Chicago River
No. Br. Chicago River
North Side Tr. Wks.
Sanitary Ship Canal
So.Br.Chgo. River
No. Br. Chicago River
North Shore Channel
5.18
9.51
13.08
16.84
18.37
21.98
22.98
26.20
30.55
34.45
35.01
37.53
39.45
40.88
42.26
45.06
46.05
47.05
49.89
Sampling Stations-River Miles Above Lockport

Figure 14.

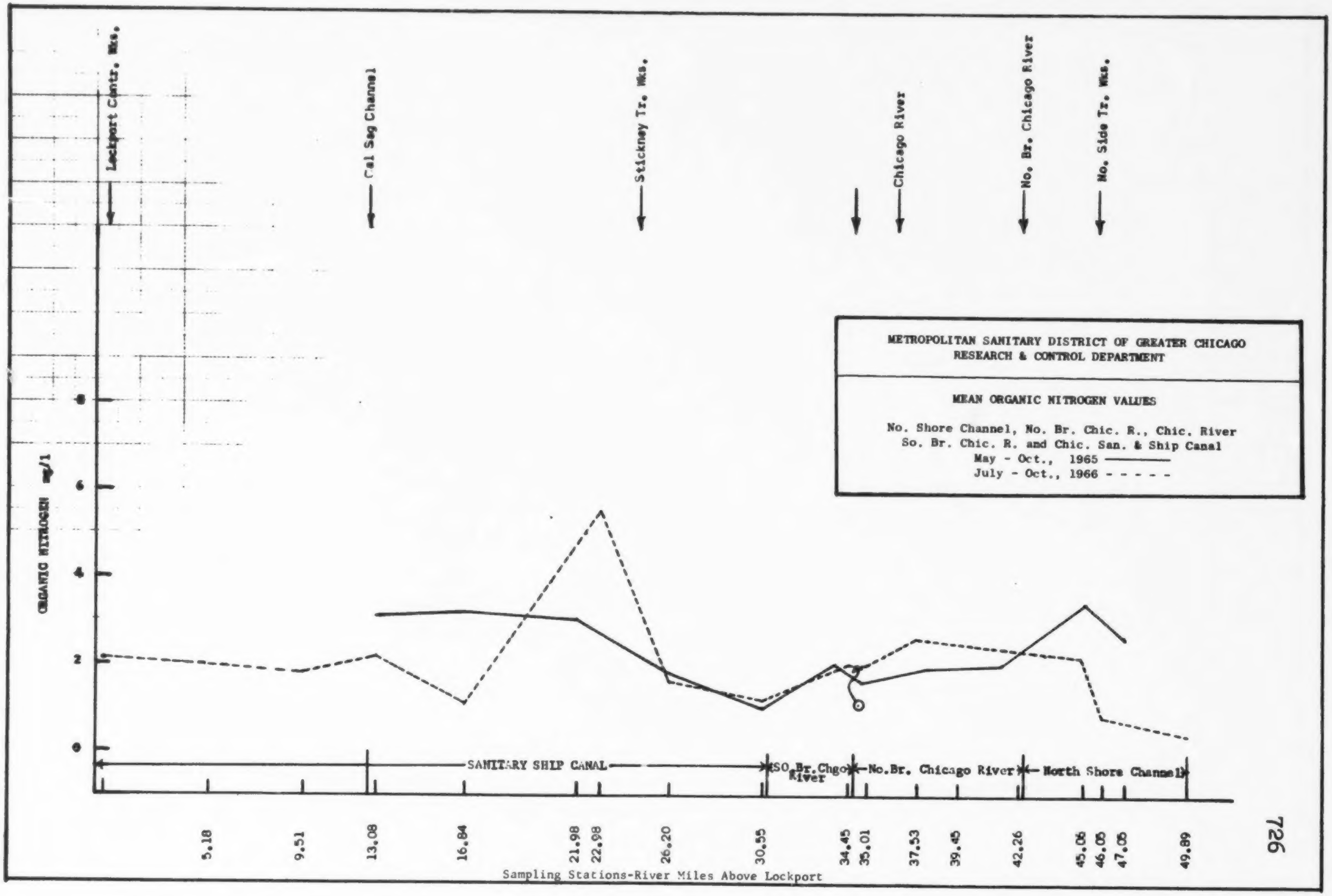

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN ORGANIC NITROGEN VALUES
No. Shore Channel, No. Br. Chic. R., Chic. River
So. Br. Chic. R. and Chic. San. & Ship Canal
May - Oct., 1965
July - Oct., 1966
Lockport Contr. Wks.
Cal Sag Channel
Stickney Tr. Wks.
Chicago River
No. Br. Chicago River
No. Side Tr. Wks.
ORGANIC NITROGEN mg/1
0
2
4
6
8
SANITARY SHIP CANAL
SO.Br.Chgo River
No.Br. Chicago River
North Shore Channel
5.18
9.51
13.08
16.84
21.98
22.98
26.20
30.55
34.45
35.01
37.53
39.45
42.26
45.06
46.05
47.05
49.89
Sampling Stations-River Miles Above Lockport

Figure 15.

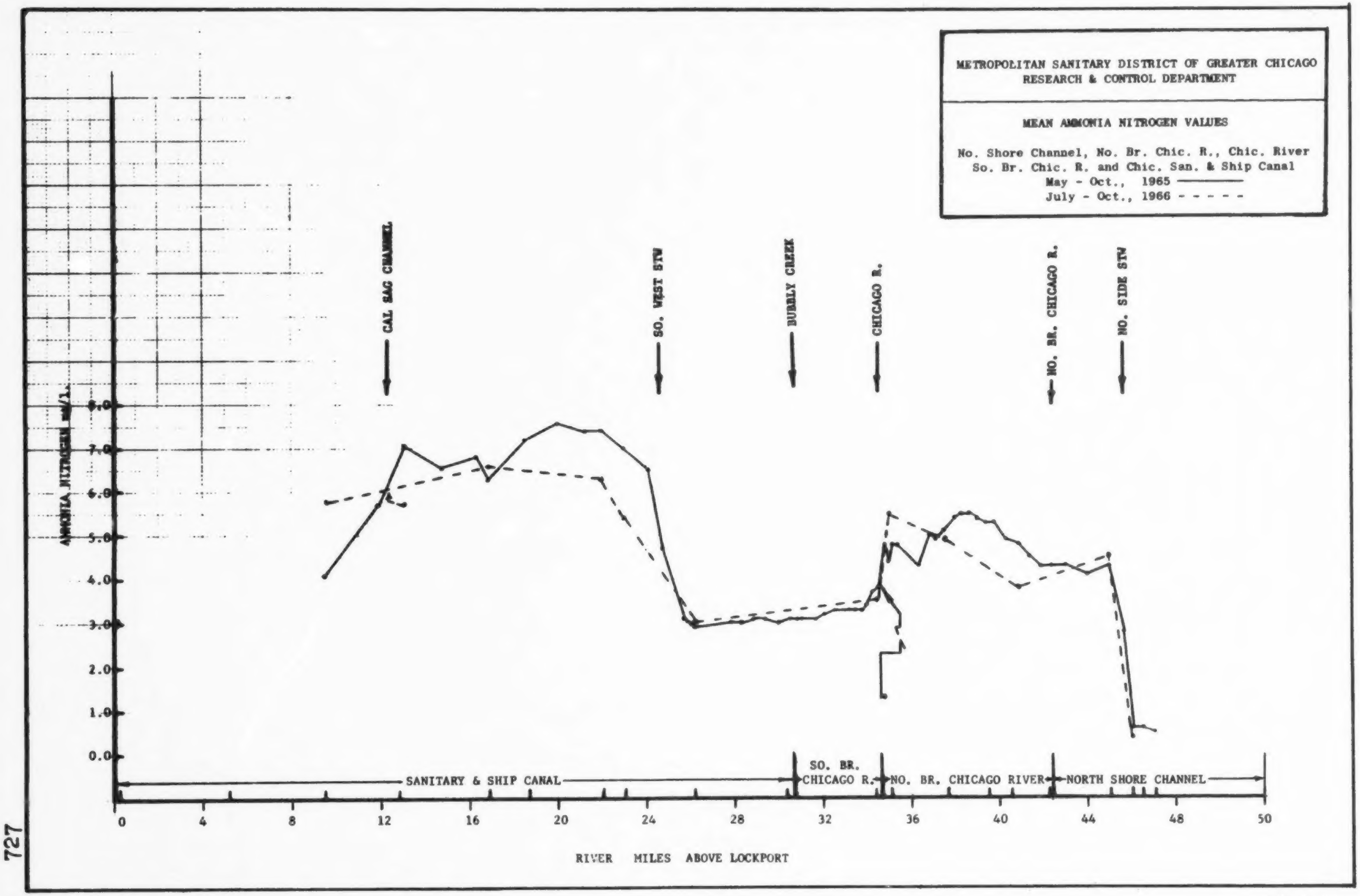
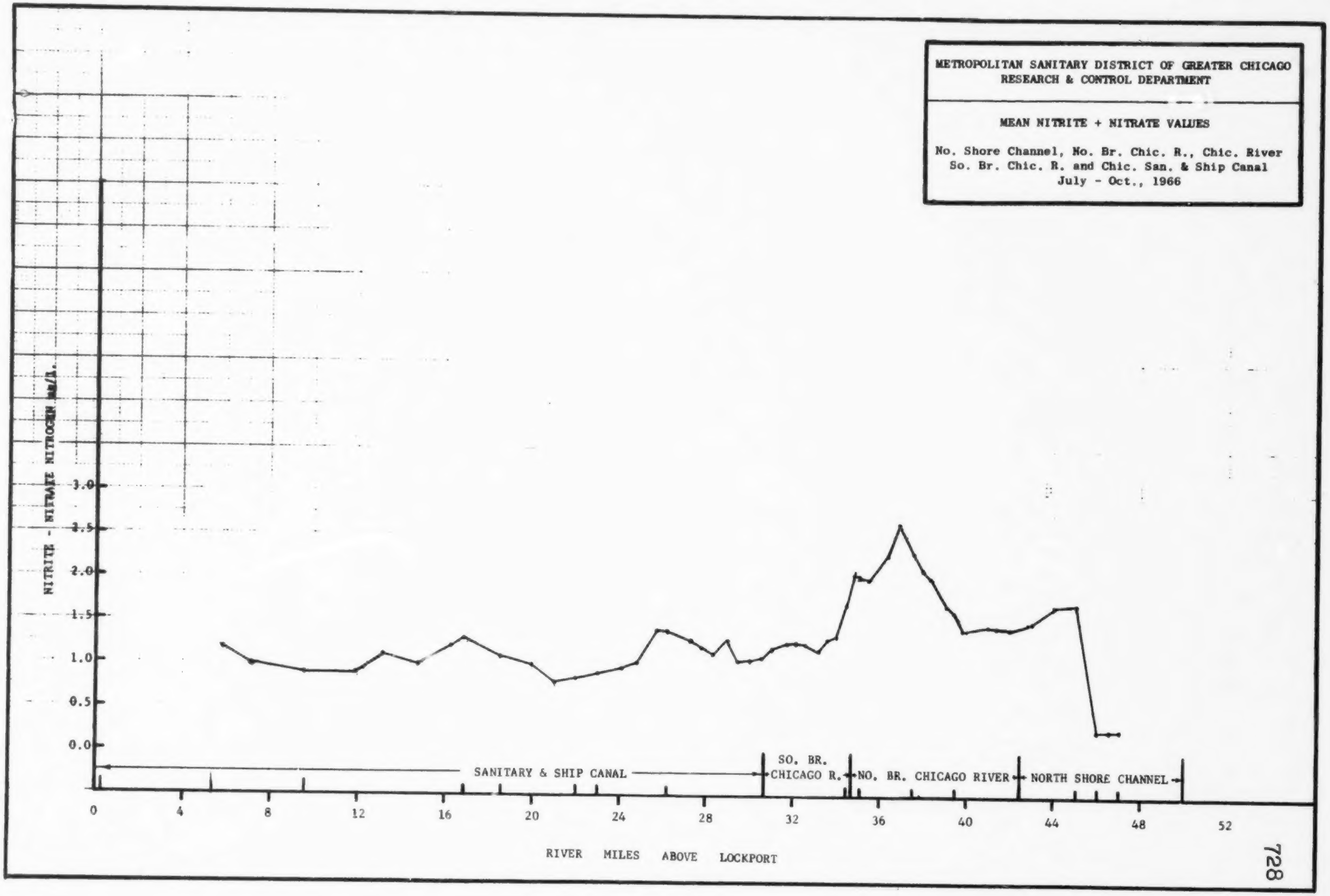

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN AMMONIA NITROGEN VALUES
No. Shore Channel, No. Br. Chic. R., Chic. River
So. Br. Chic. R. and Chic. San. & Ship Canal
May - Oct., 1965
July - Oct., 1966
AMMONIA NITROGEN mg/l.
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
CAL SAG CHANNEL
SO. WEST STW
BUBBLY CREEK
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
SANITARY & SHIP CANAL
SO. BR. CHICAGO R.
NO. BR. CHICAGO RIVER
NORTH SHORE CHANNEL
0
4
8
12
16
20
24
28
32
36
40
44
48
50
RIVER MILES ABOVE LOCKPORT

Figure 16.

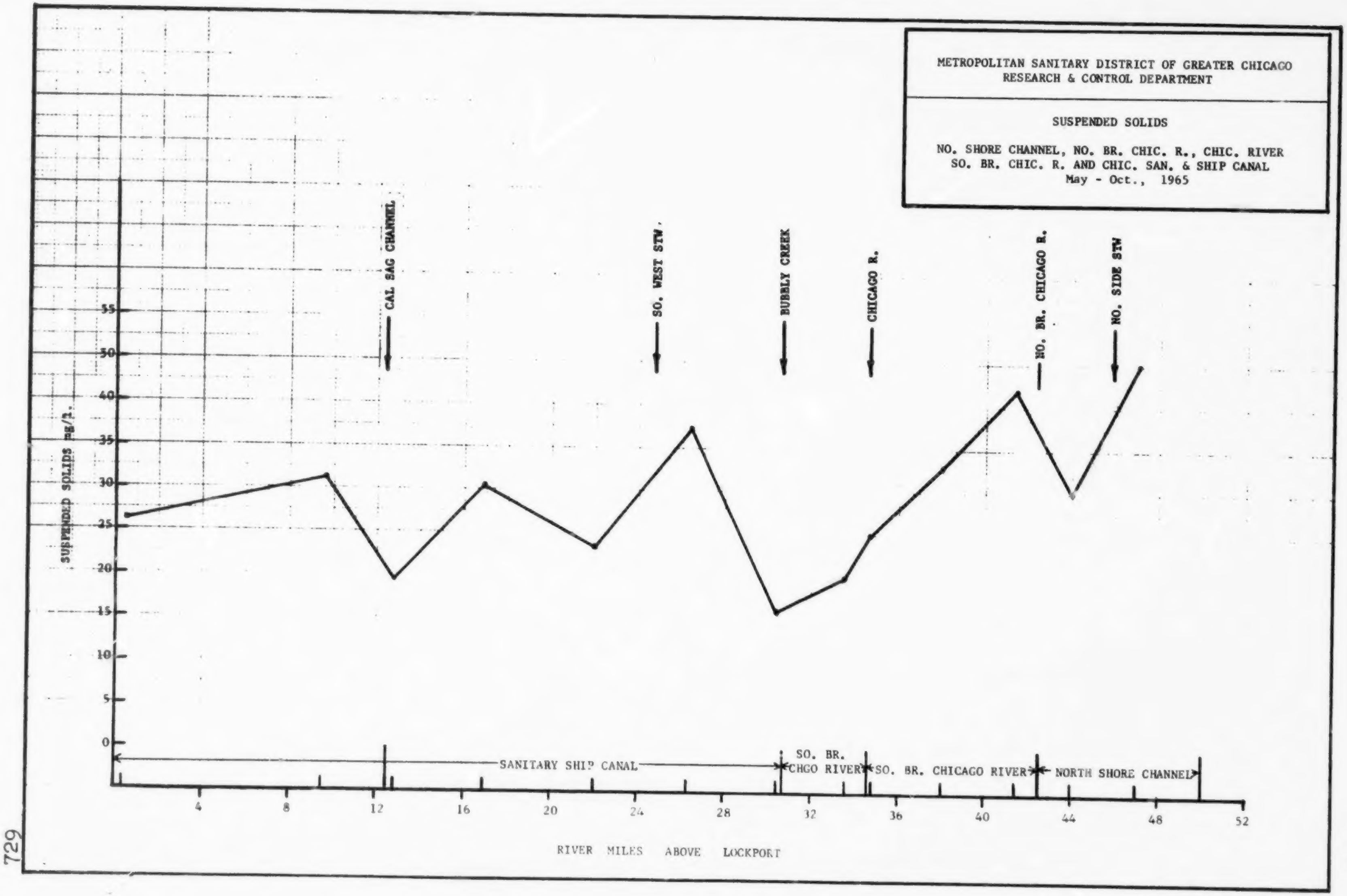


METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT

MEAN NITRITE + NITRATE VALUES

No. Shore Channel, No. Br. Chic. R., Chic. River
So. Br. Chic. R. and Chic. San. & Ship Canal
July - Oct., 1966

Figure 17.

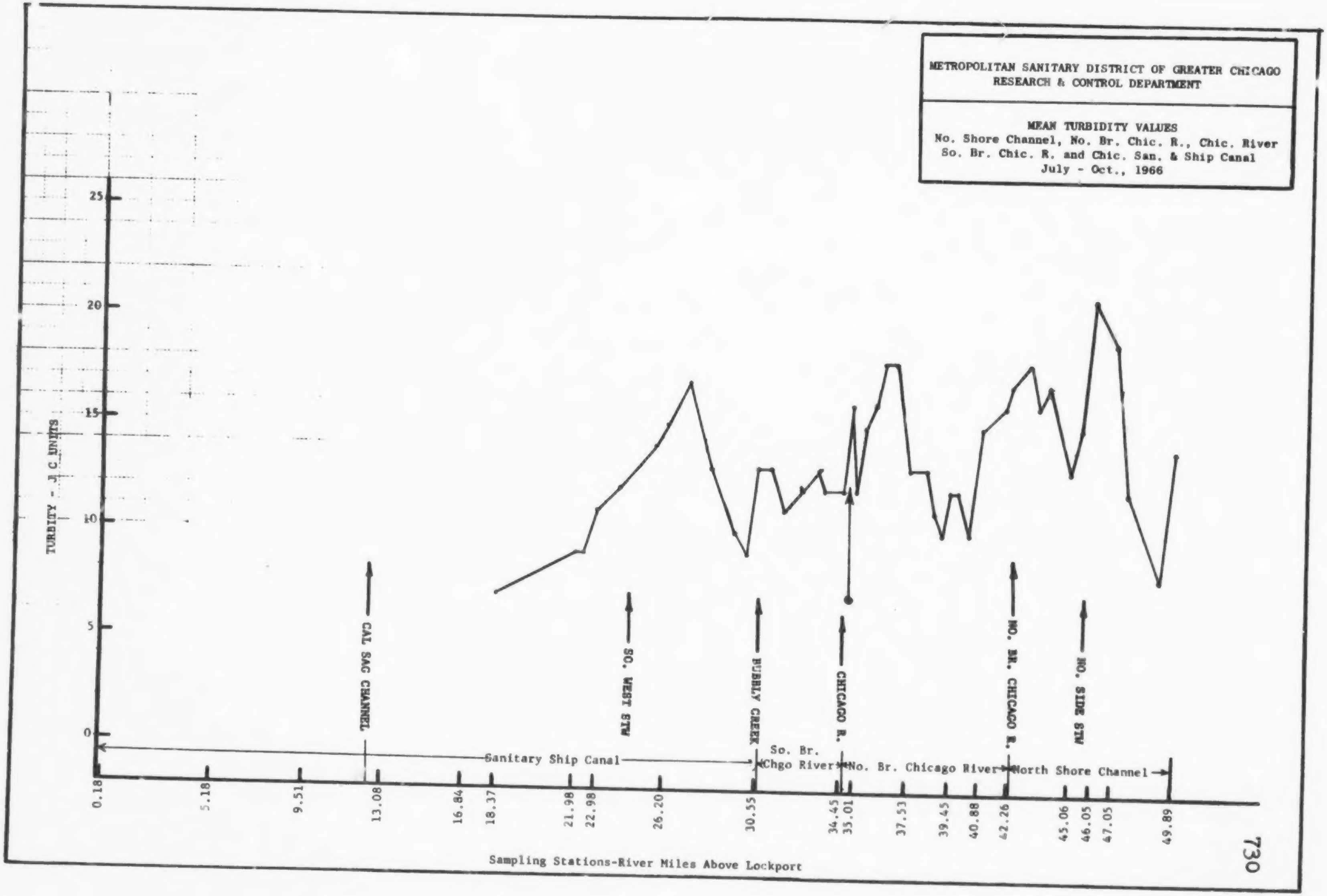


METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT

SUSPENDED SOLIDS

NO. SHORE CHANNEL, NO. BR. CHIC. R., CHIC. RIVER
SO. BR. CHIC. R. AND CHIC. SAN. & SHIP CANAL
May - Oct., 1965

Figure 18.



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT

MEAN TURBIDITY VALUES
No. Shore Channel, No. Br. Chic. R., Chic. River
So. Br. Chic. R. and Chic. San. & Ship Canal
July - Oct., 1966

Figure 19.

NO. 340R-10½ DIETZGEN GRAPH PAPER
10 X 10 PER HALF INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

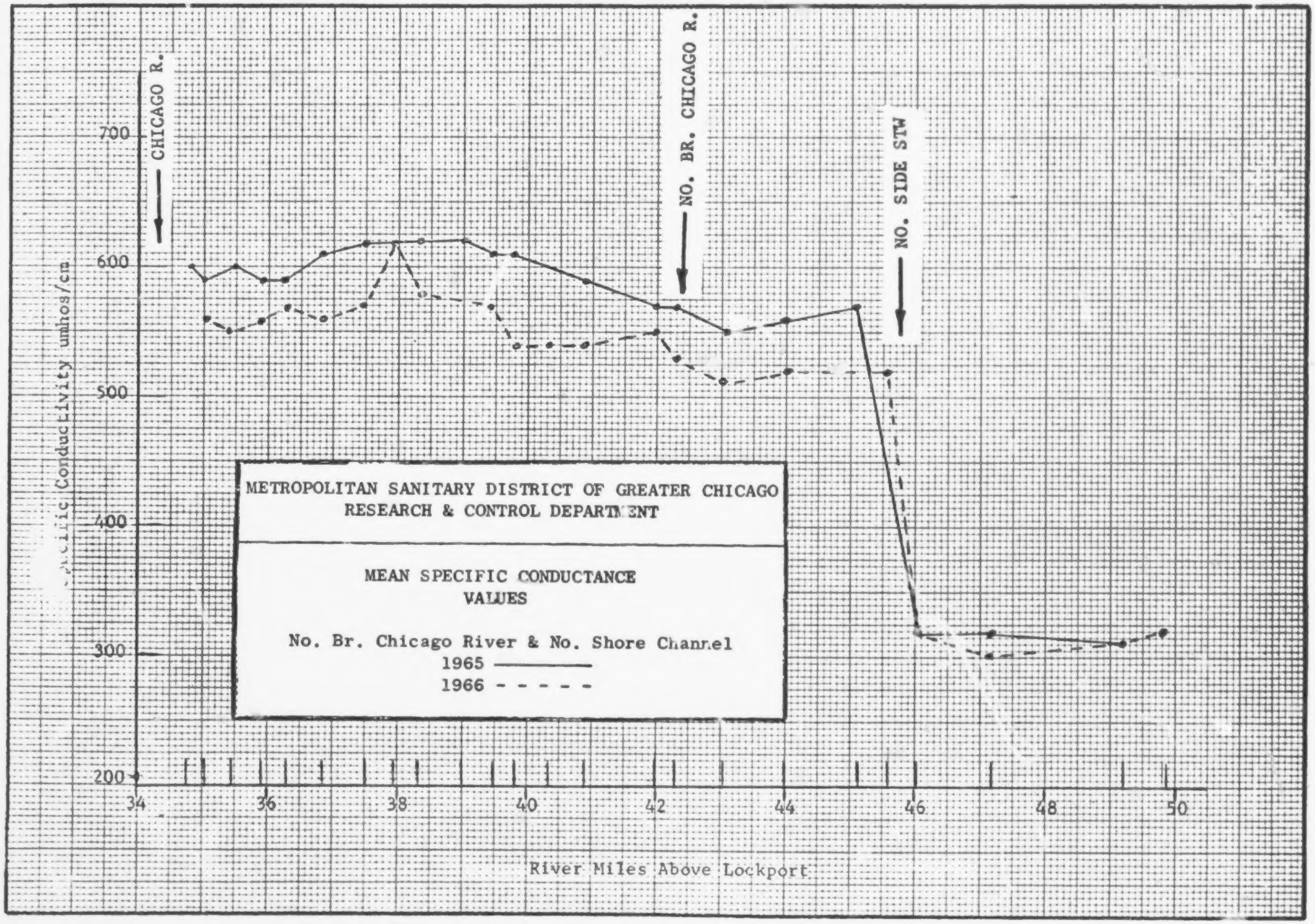


Figure 20.

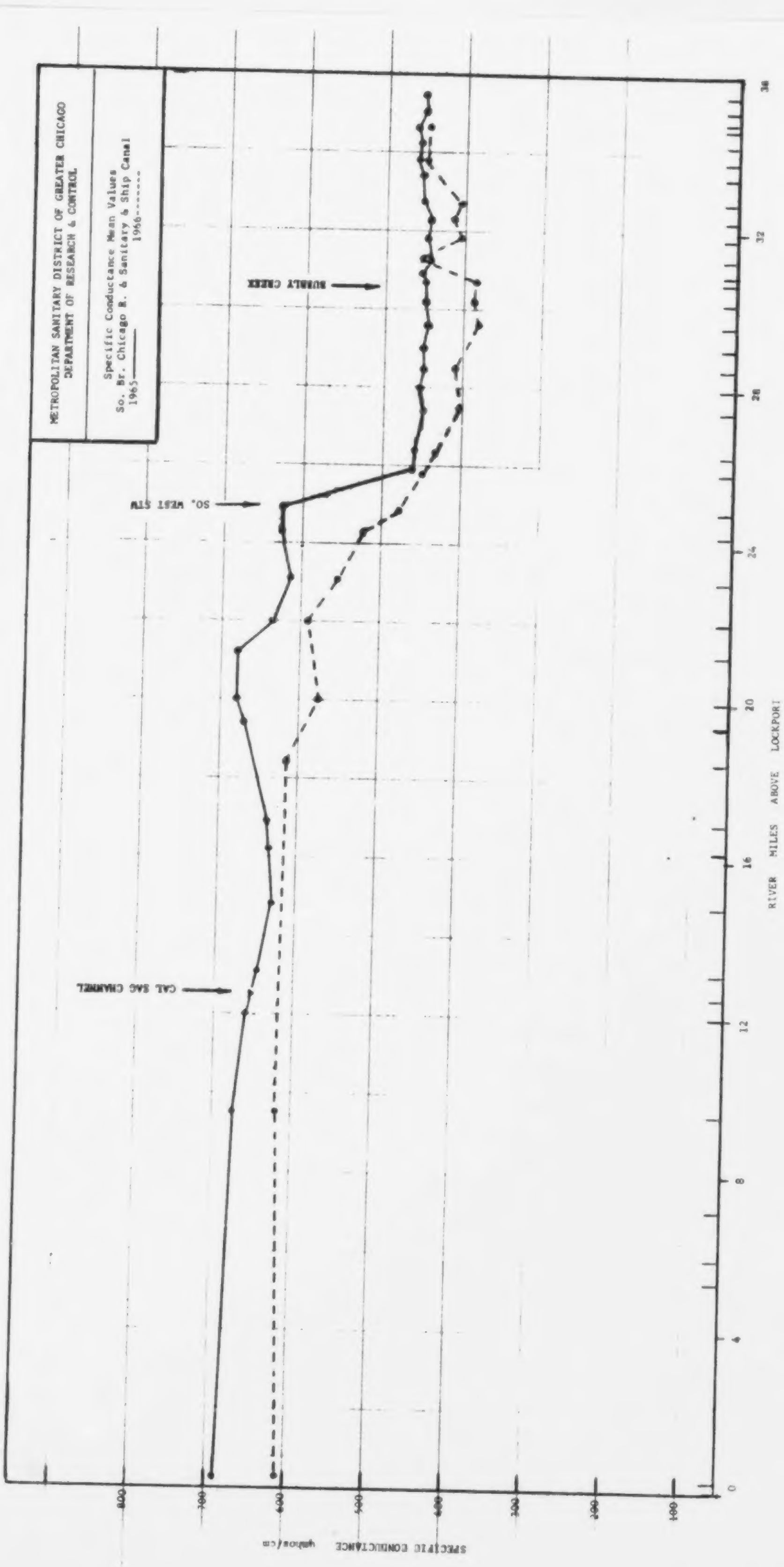

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL
Specific Conductance Mean Values
So. Br. Chicago R. & Sanitary & Ship Canal
1965———
1966-------
BUBBLY CREEK
SO. WEST STW
CAL SAG CHANNEL
800
700
600
500
400
300
200
100
SPECIFIC CONDUCTANCE µmhos/cm
0
4
8
12
16
20
24
28
32
36
RIVER MILES ABOVE LOCKPORT

Figure 21.

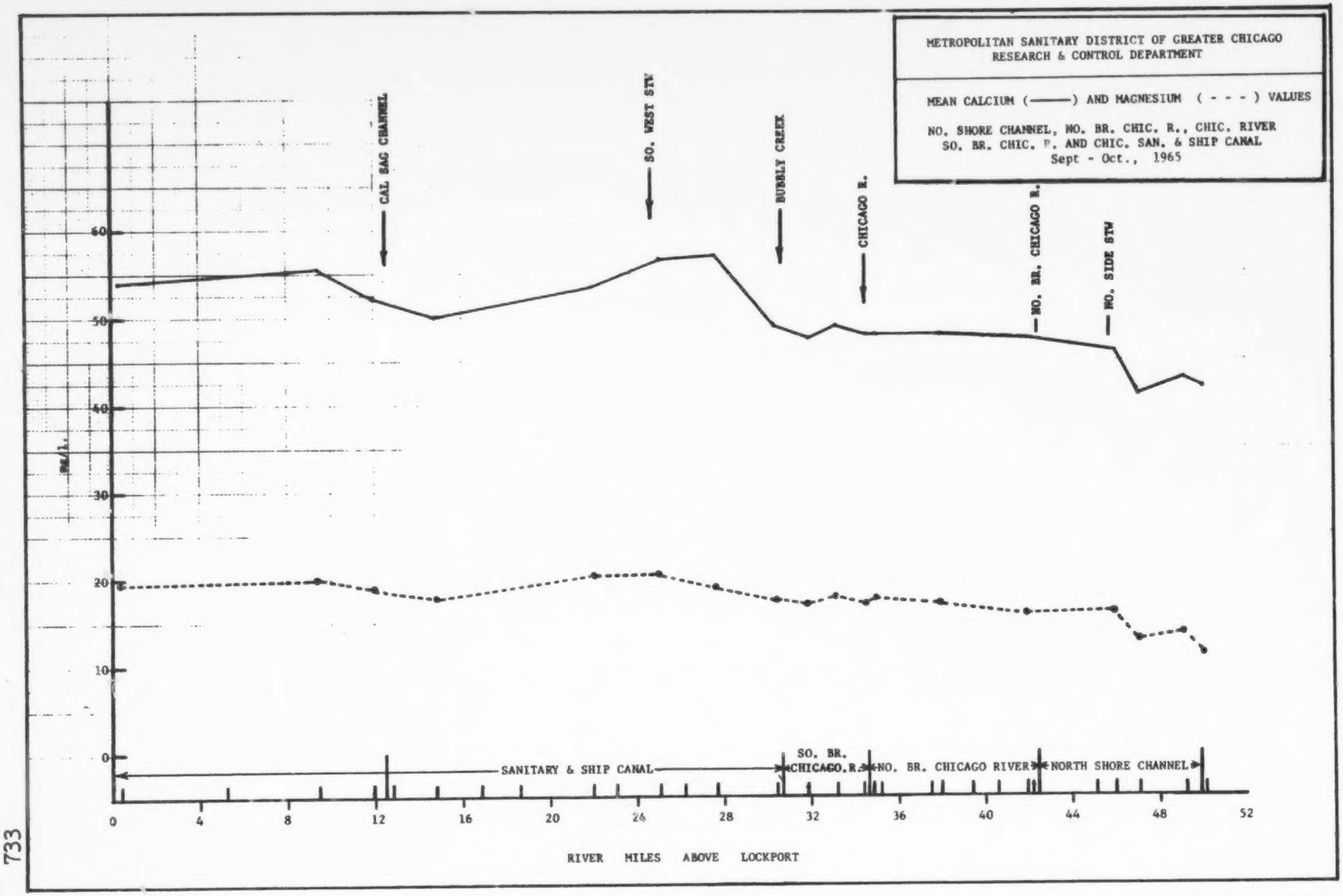

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH & CONTROL DEPARTMENT
MEAN CALCIUM (———) AND MAGNESIUM (- - -) VALUES
NO. SHORE CHANNEL, NO. BR. CHIC. R., CHIC. RIVER
SO. BR. CHIC. R. AND CHIC. SAN. & SHIP CANAL
Sept - Oct., 1965
CAL SAG CHANNEL
SO. WEST STW
BUBBLY CREEK
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
mg/l.
60
50
40
30
20
10
0
SANITARY & SHIP CANAL
SO. BR. CHICAGO. R.
NO. BR. CHICAGO RIVER
NORTH SHORE CHANNEL
0
4
8
12
16
20
24
28
32
36
40
44
48
52
RIVER MILES ABOVE LOCKPORT

Figure 22.

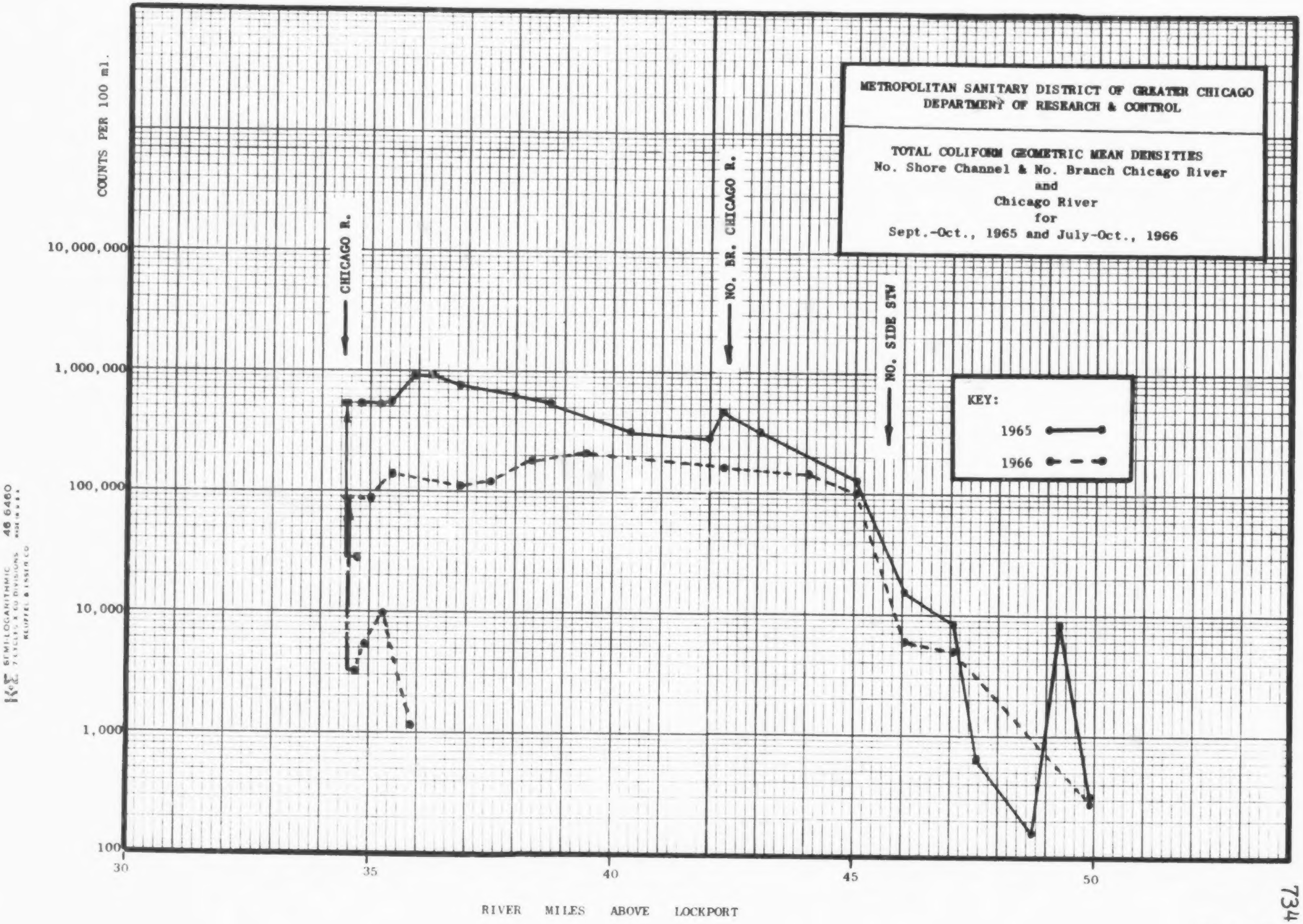

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL
TOTAL COLIFORM GEOMETRIC MEAN DENSITIES
No. Shore Channel & No. Branch Chicago River
and
Chicago River
for
Sept.-Oct., 1965 and July-Oct., 1966
KEY:
1965
1966
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
COUNTS PER 100 ml.
10,000,000
1,000,000
100,000
10,000
1,000
100
30
35
40
45
50
RIVER MILES ABOVE LOCKPORT
K&E SEMI-LOGARITHMIC 46 6460
7 CYCLES X 60 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

Figure 23.

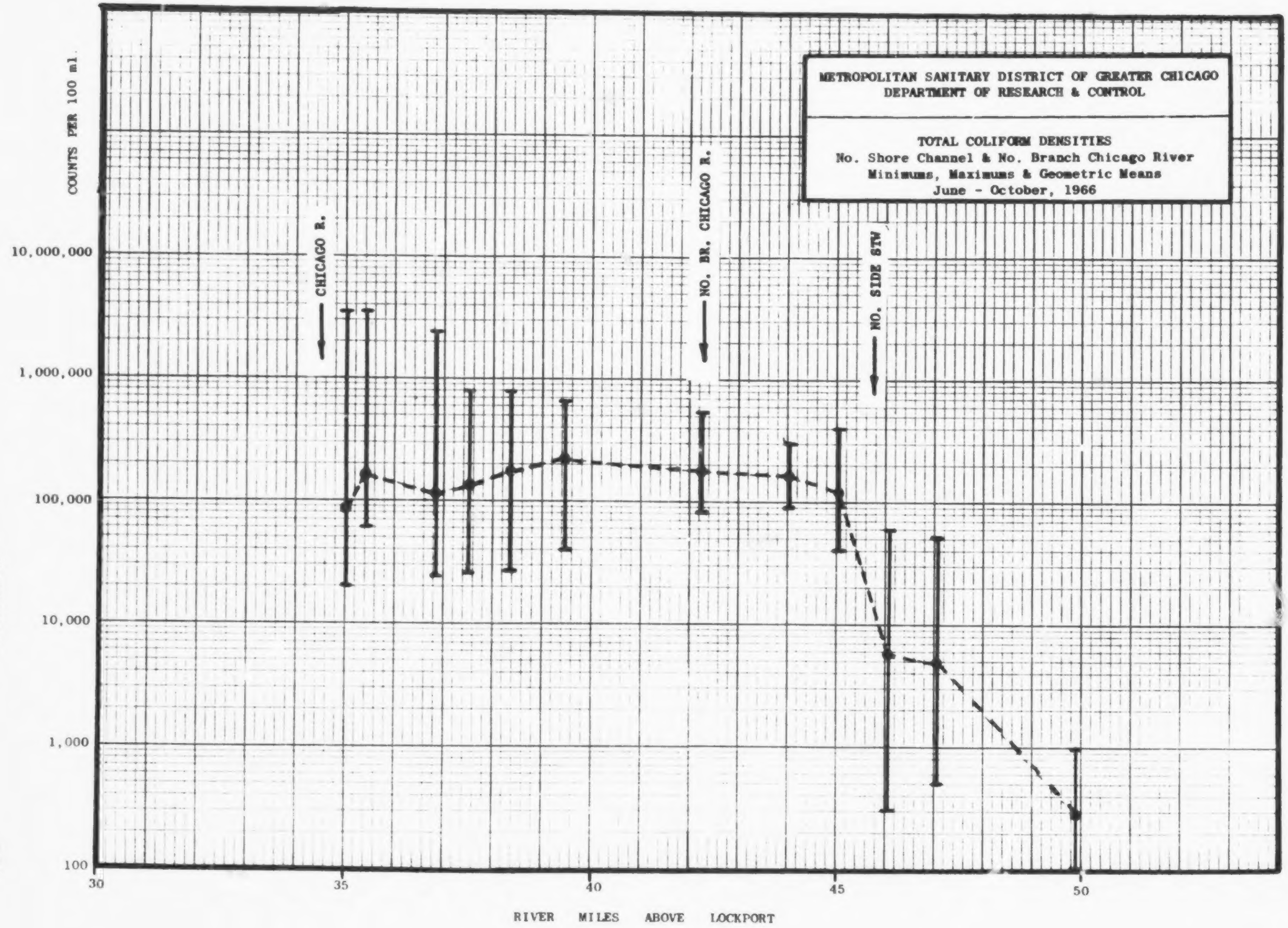


Figure 24.

SEMI-LOGARITHMIC 46 6460
ESSER CO.

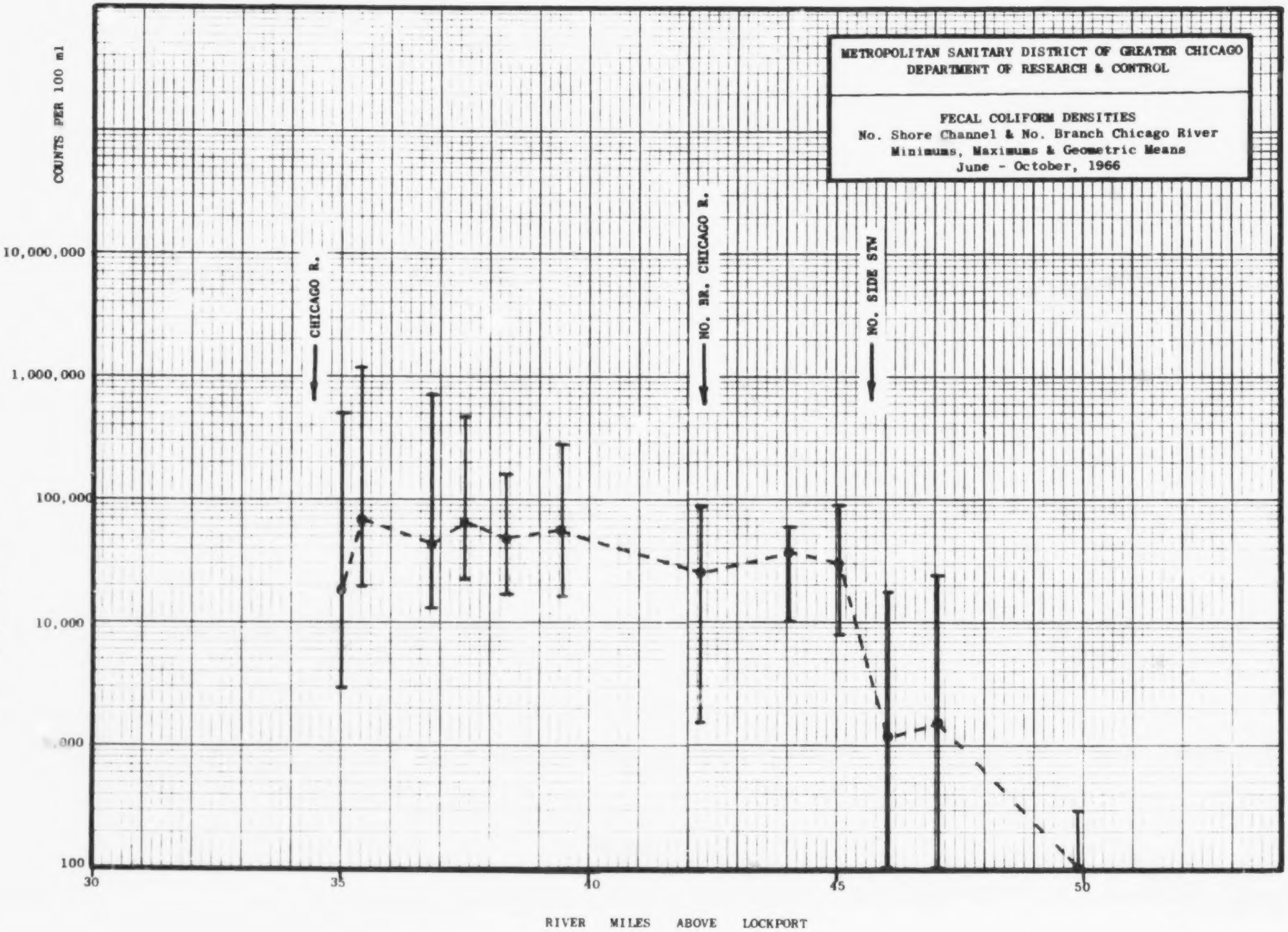

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL
FECAL COLIFORM DENSITIES
No. Shore Channel & No. Branch Chicago River
Minimums, Maximums & Geometric Means
June - October, 1966
COUNTS PER 100 ml
10,000,000
1,000,000
100,000
10,000
1,000
100
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
30
35
40
45
50
RIVER MILES ABOVE LOCKPORT

Figure 25

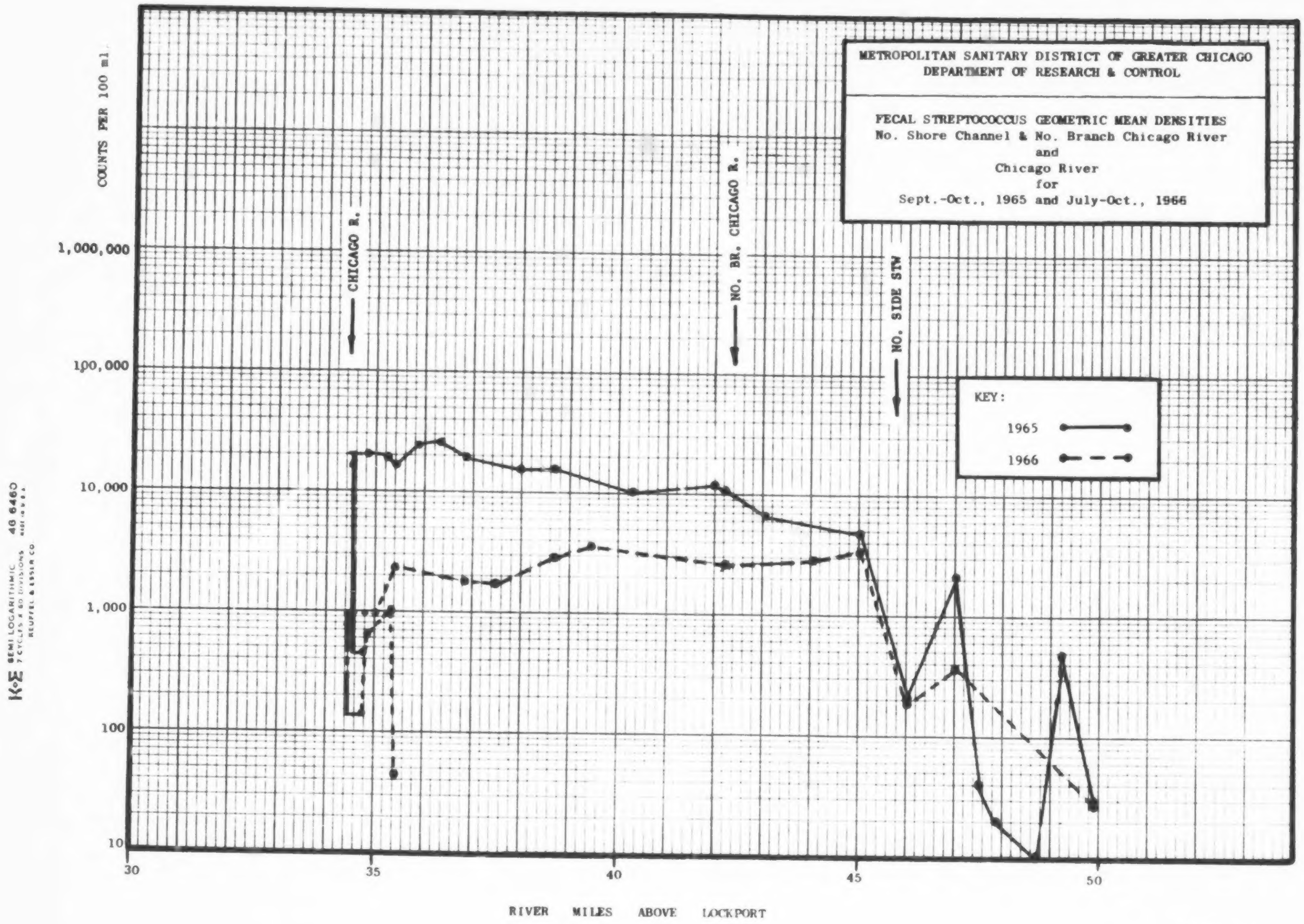

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL
FECAL STREPTOCOCCUS GEOMETRIC MEAN DENSITIES
No. Shore Channel & No. Branch Chicago River
and
Chicago River
for
Sept.-Oct., 1965 and July-Oct., 1966
KEY:
1965
1966
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
COUNTS PER 100 ml
1,000,000
100,000
10,000
1,000
100
10
30
35
40
45
50
RIVER MILES ABOVE LOCKPORT
K&E SEMI-LOGARITHMIC 46 6460
7 CYCLES X 80 DIVISIONS
KEUFFEL & ESSER CO.

Figure 26

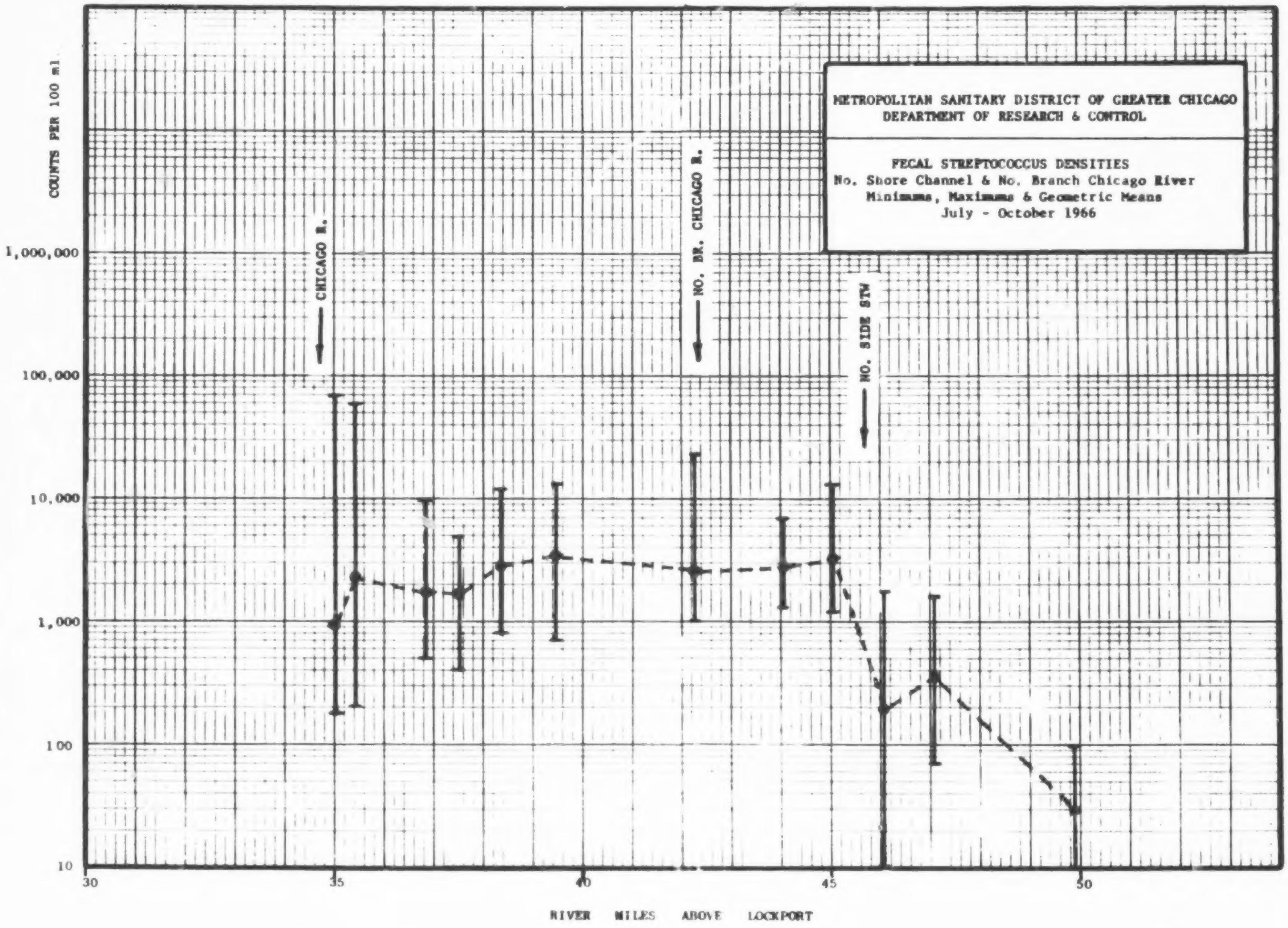
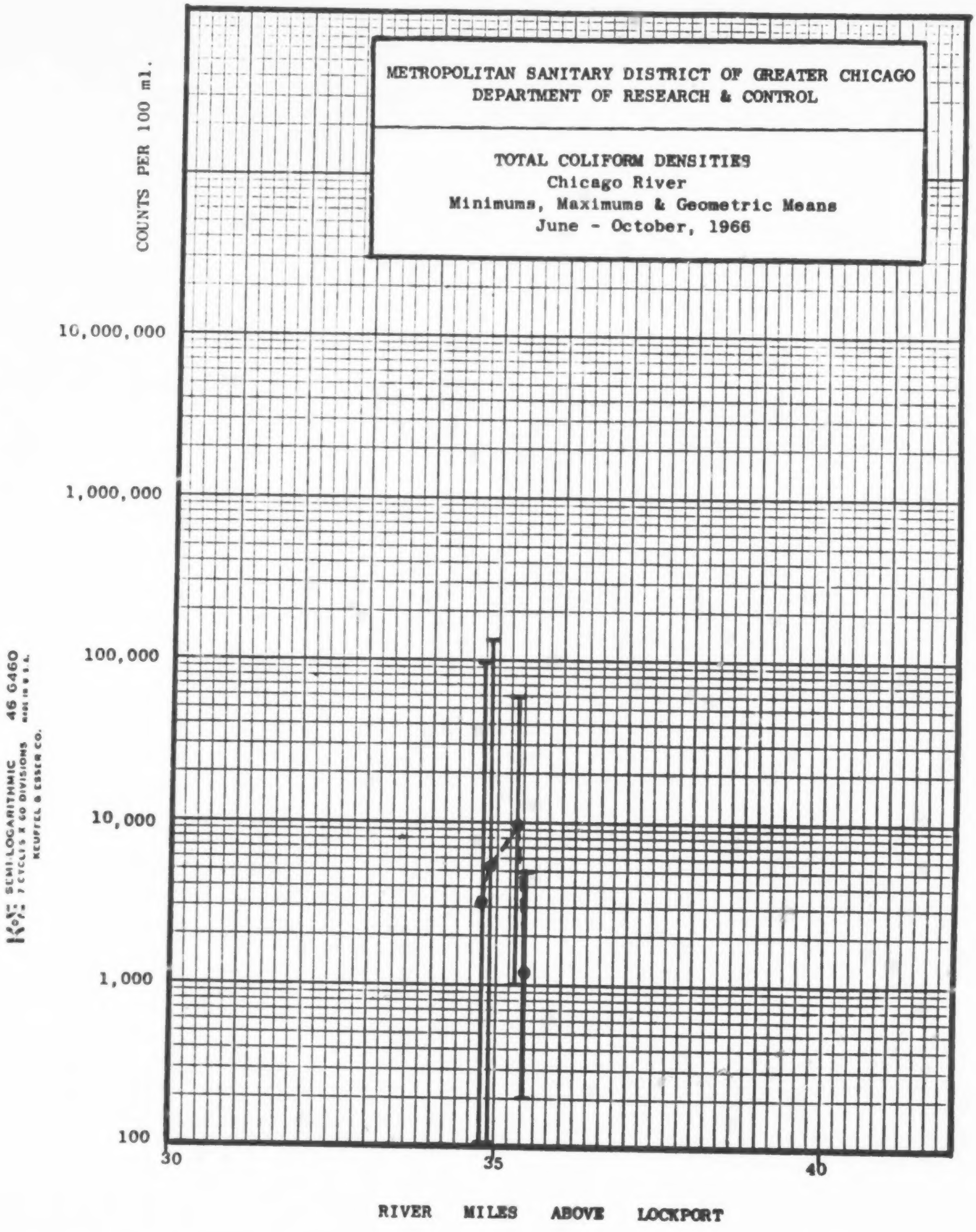

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL
FECAL STREPTOCOCCUS DENSITIES
No. Shore Channel & No. Branch Chicago River
Minimums, Maximums & Geometric Means
July - October 1966
CHICAGO R.
NO. BR. CHICAGO R.
NO. SIDE STW
COUNTS PER 100 ml
1,000,000
100,000
10,000
1,000
100
10
30
35
40
45
50
RIVER MILES ABOVE LOCKPORT

Figure 27



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL

TOTAL COLIFORM DENSITIES
Chicago River
Minimums, Maximums & Geometric Means
June - October, 1966

Figure 28

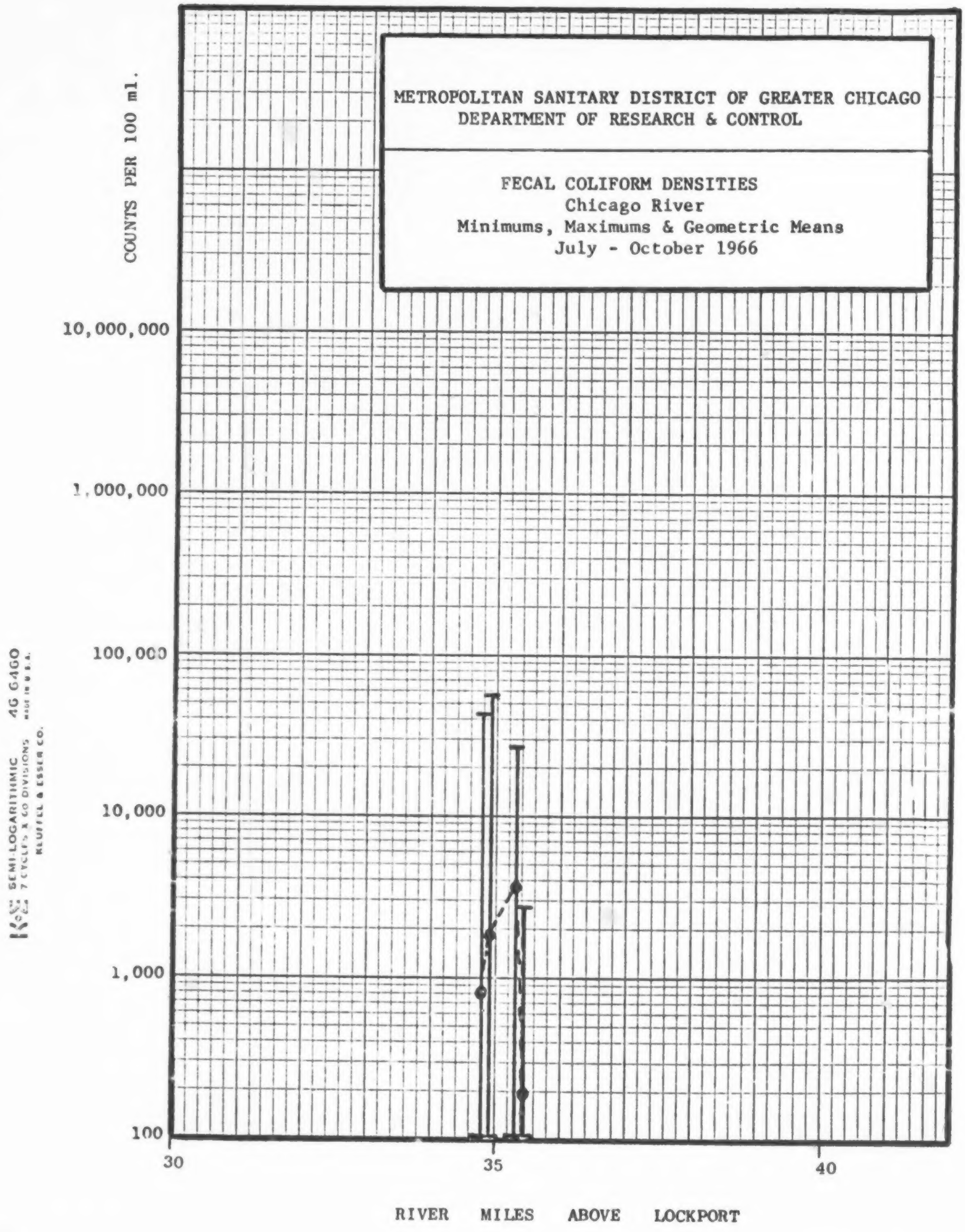
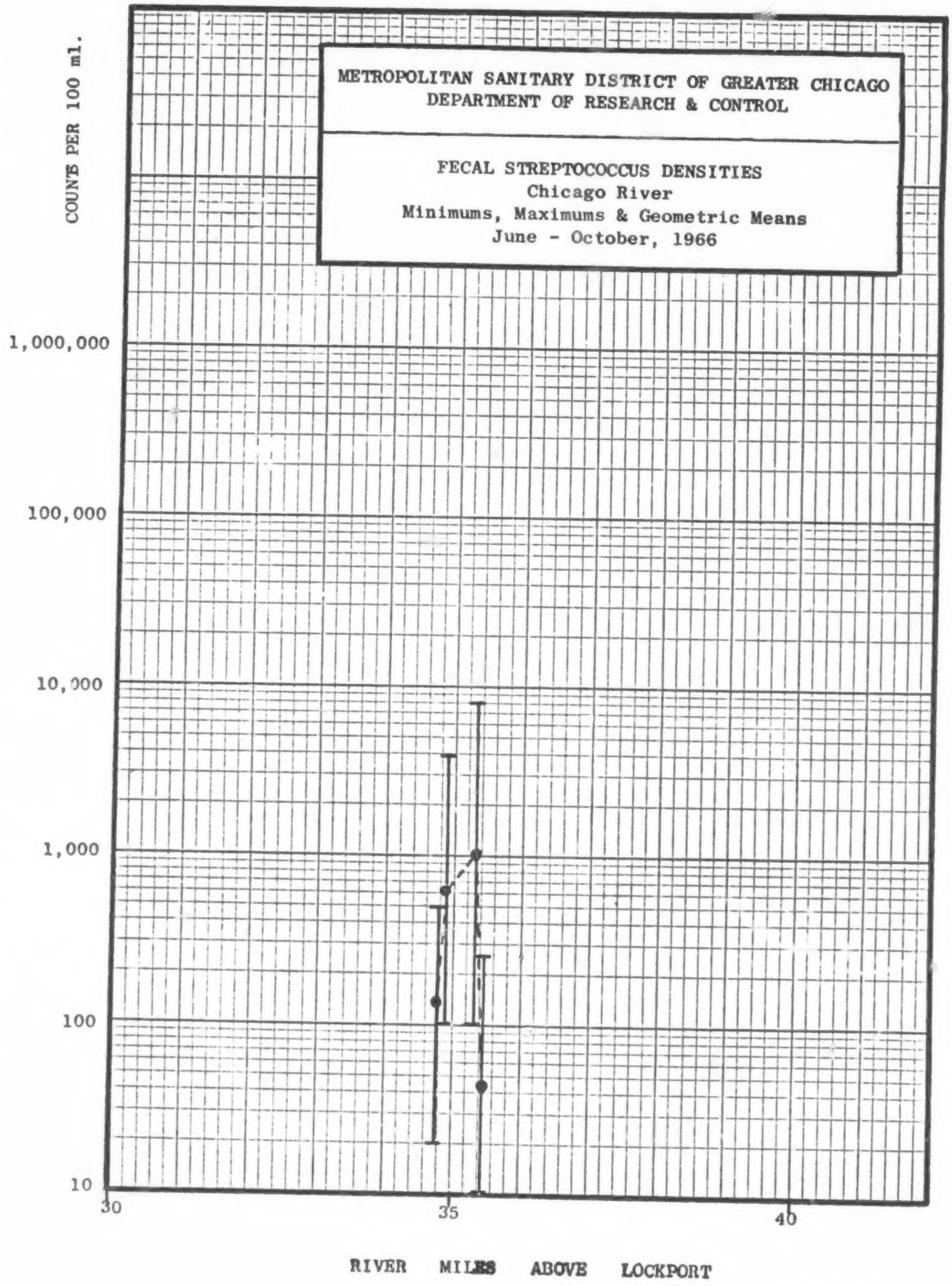

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL
FECAL COLIFORM DENSITIES
Chicago River
Minimums, Maximums & Geometric Means
July - October 1966
COUNTS PER 100 ml.
10,000,000
1,000,000
100,000
10,000
1,000
100
30
35
40
RIVER MILES ABOVE LOCKPORT
K&E SEMI-LOGARITHMIC 46 6460
7 CYCLES X 60 DIVISIONS
KEUFFEL & ESSER CO.

Figure 29



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL

FECAL STREPTOCOCCUS DENSITIES
Chicago River
Minimums, Maximums & Geometric Means
June - October, 1966

Figure 30

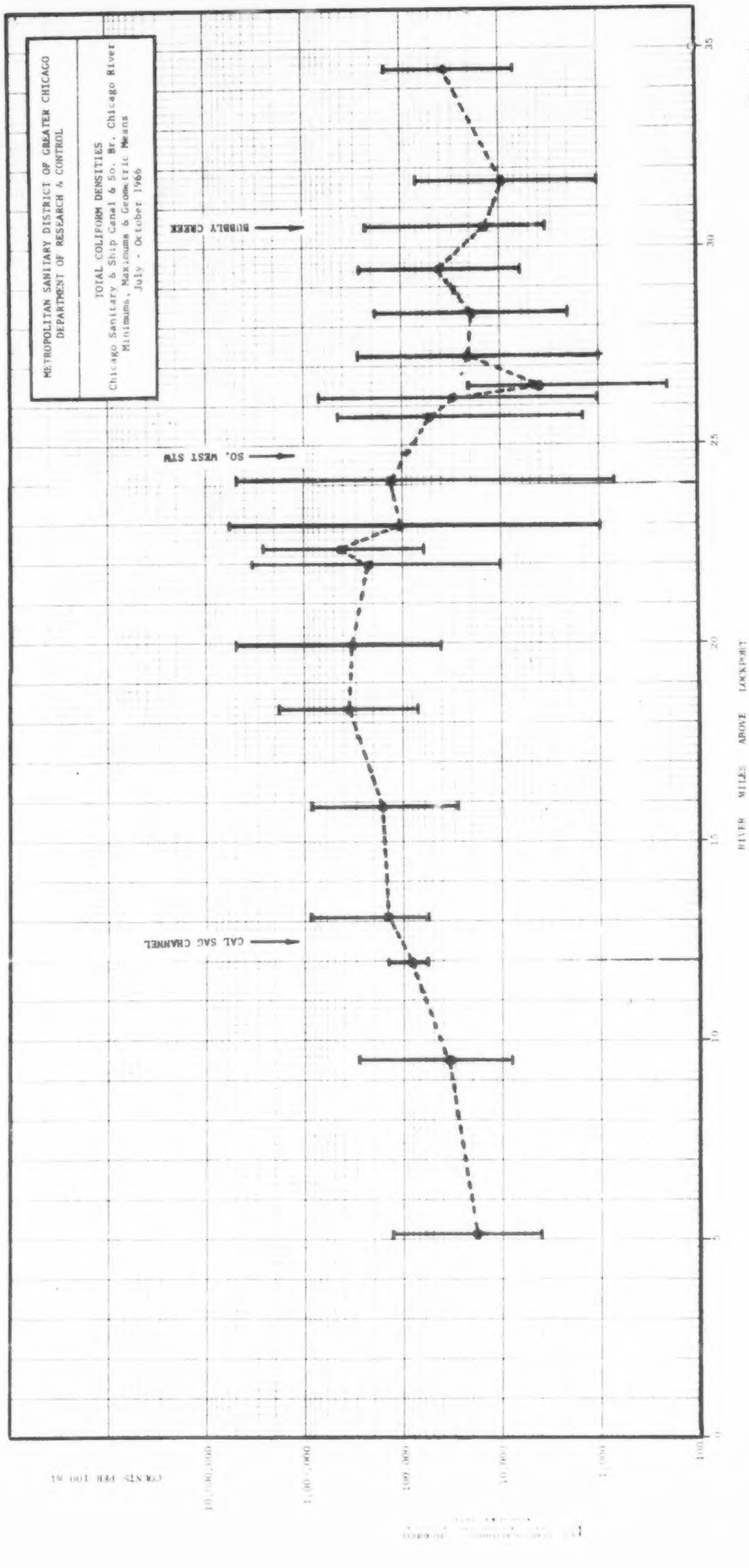
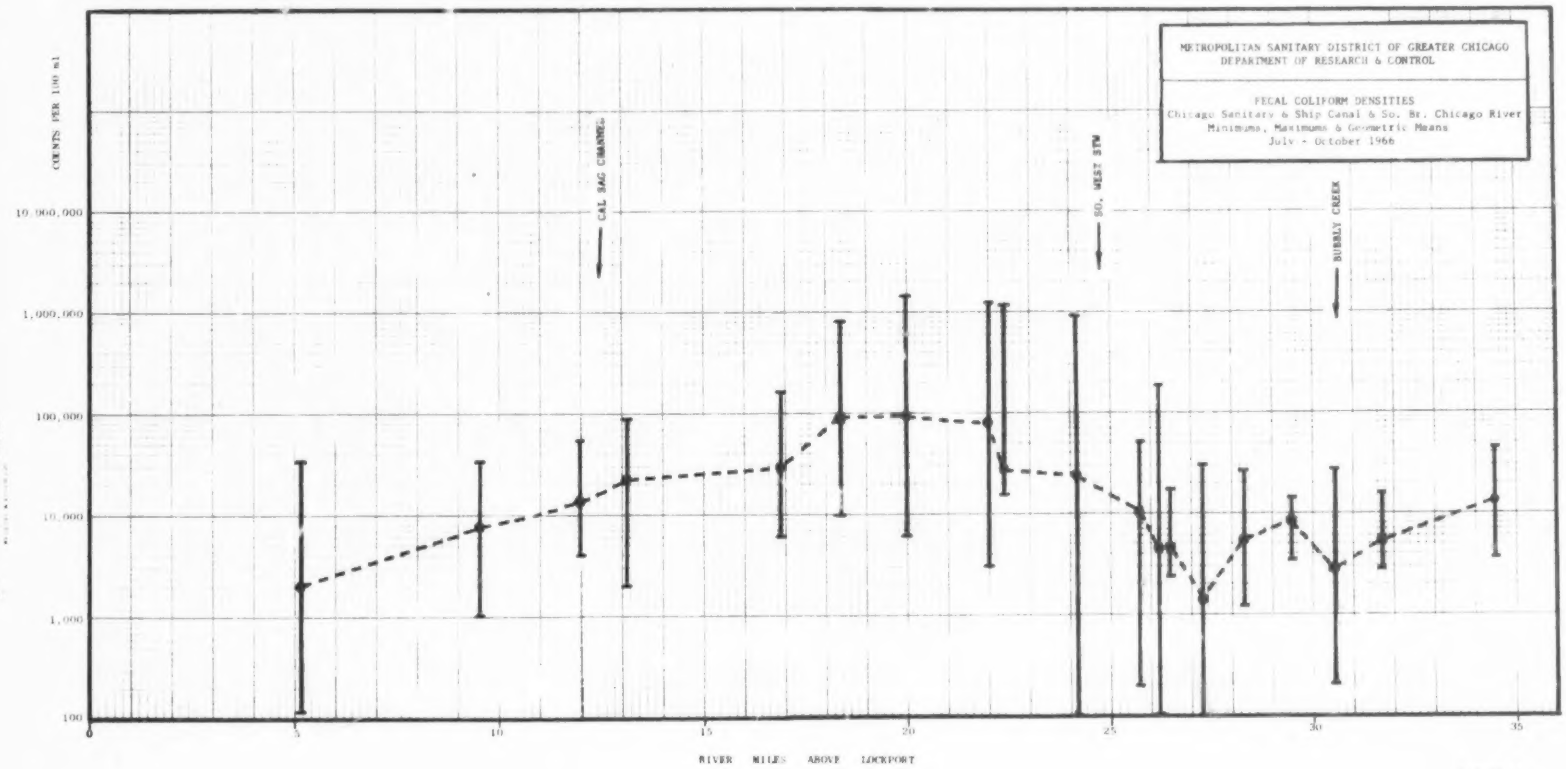

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL
TOTAL COLIFORM DENSITIES
Chicago Sanitary & Ship Canal & So. Br. Chicago River
Minimums, Maximums & Geometric Means
July - October 1966
BUBBLY CREEK
SO. WEST STW
CAL SAG CHANNEL
0
5
10
15
20
25
30
35
RIVER MILES ABOVE LOCKPORT
100
1,000
10,000
100,000
1,000,000
10,000,000
COUNTS PER 100 ML

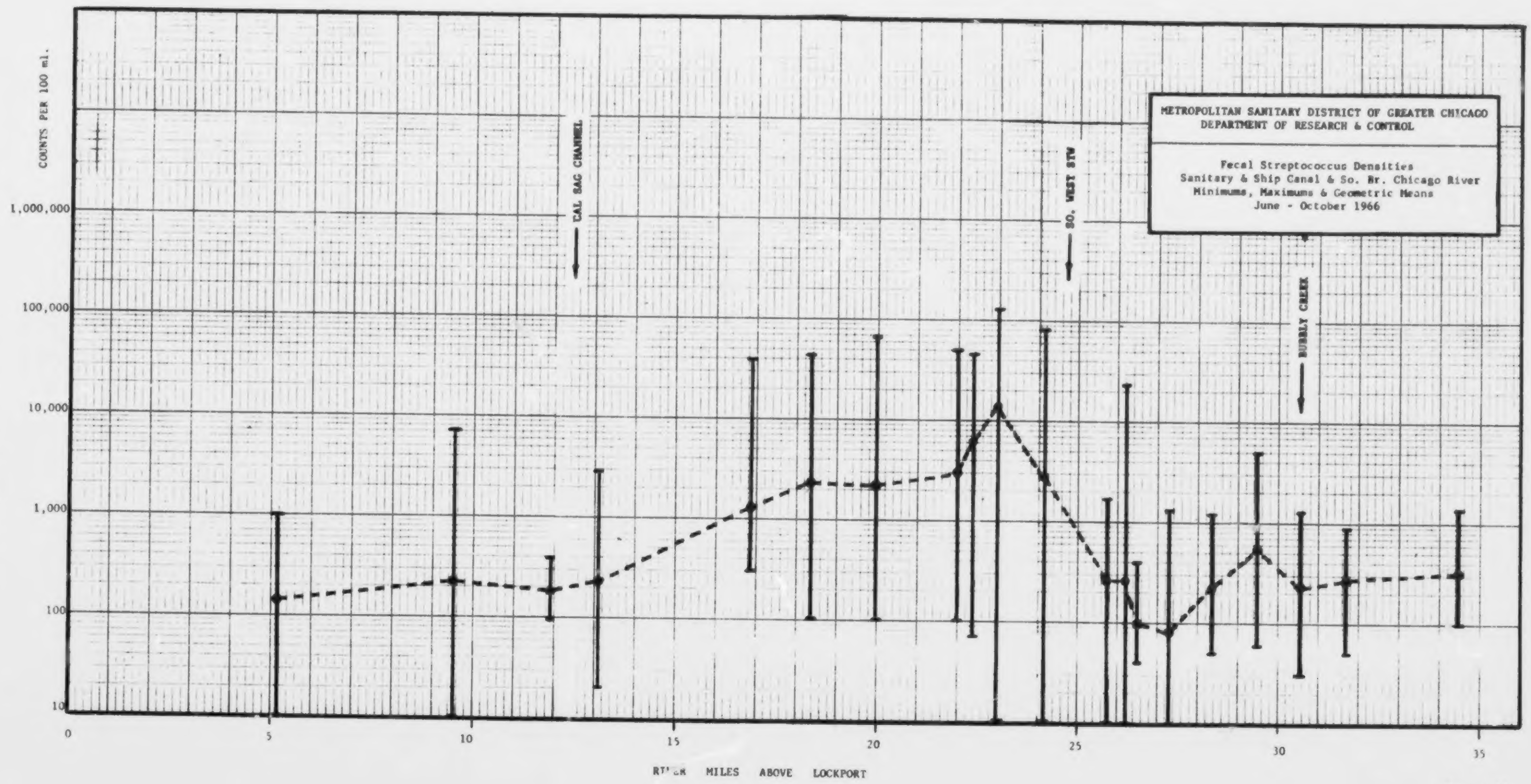
Figure 31



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL

FECAL COLIFORM DENSITIES
Chicago Sanitary & Ship Canal & So. Br. Chicago River
Minimums, Maximums & Geometric Means
July - October 1966

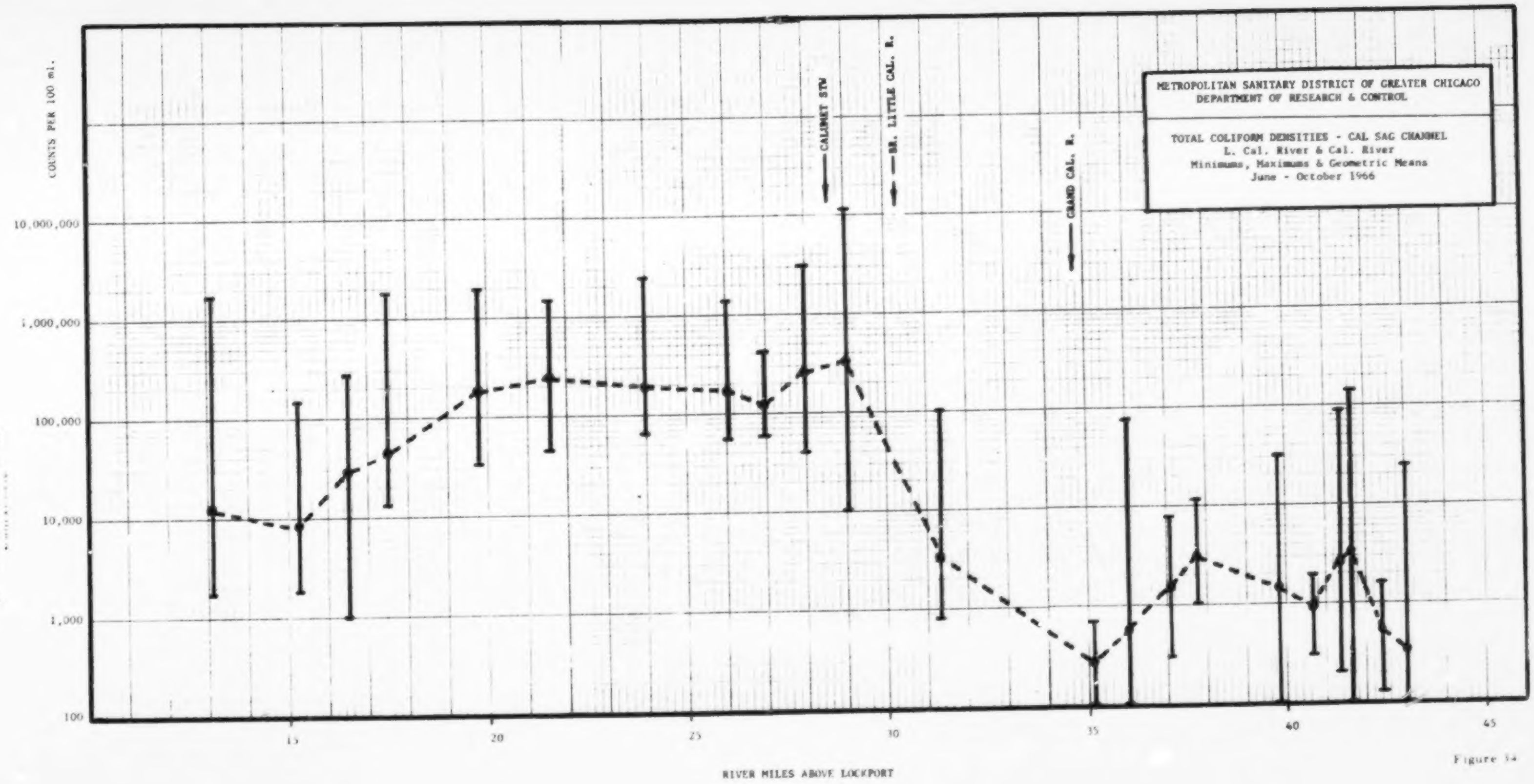
Figure 32



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL

Fecal Streptococcus Densities
Sanitary & Ship Canal & So. Br. Chicago River
Minimums, Maximums & Geometric Means
June - October 1966

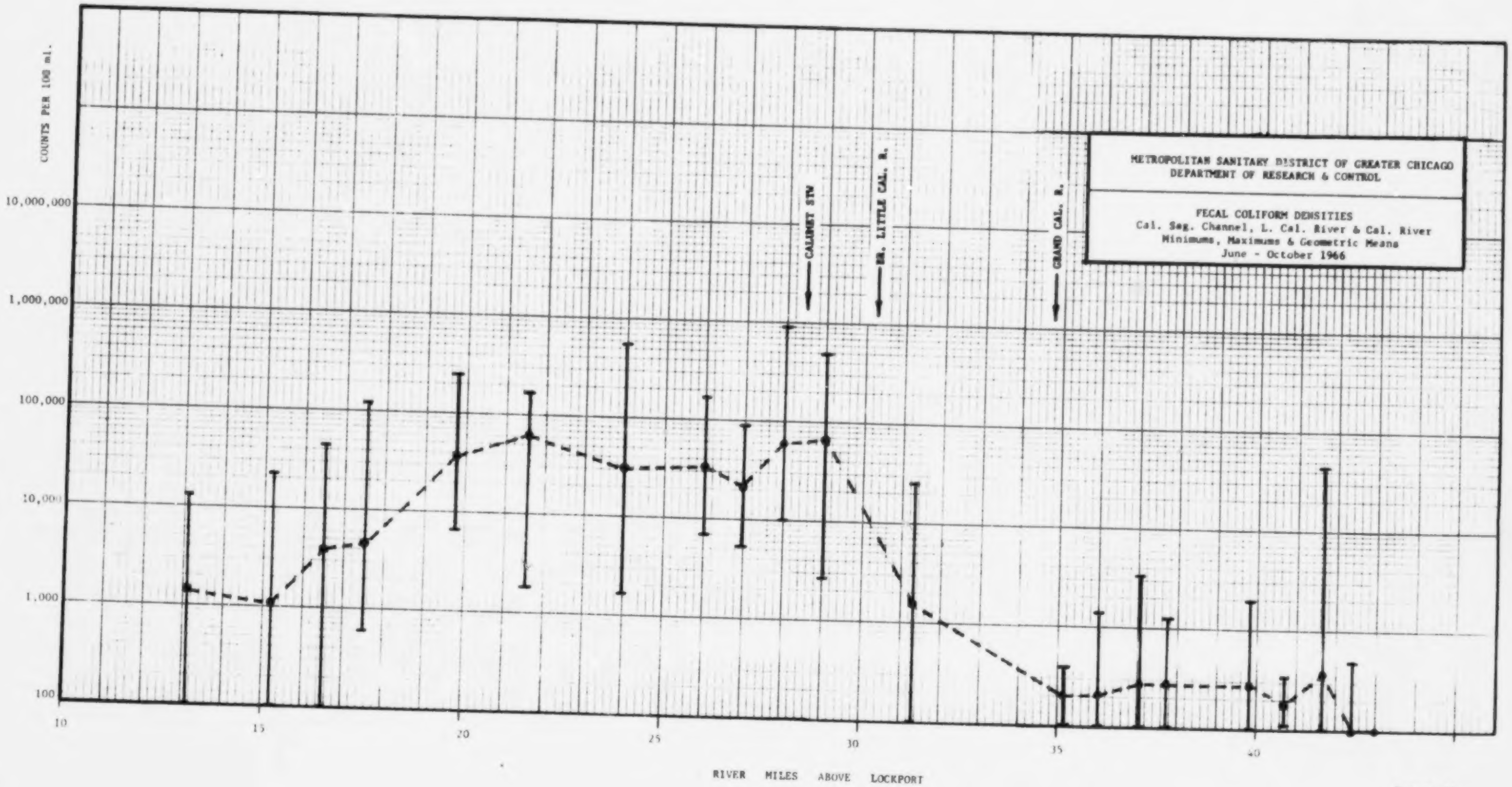
Figure 33



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL

TOTAL COLIFORM DENSITIES - CAL SAG CHANNEL
L. Cal. River & Cal. River
Minimums, Maximums & Geometric Means
June - October 1966

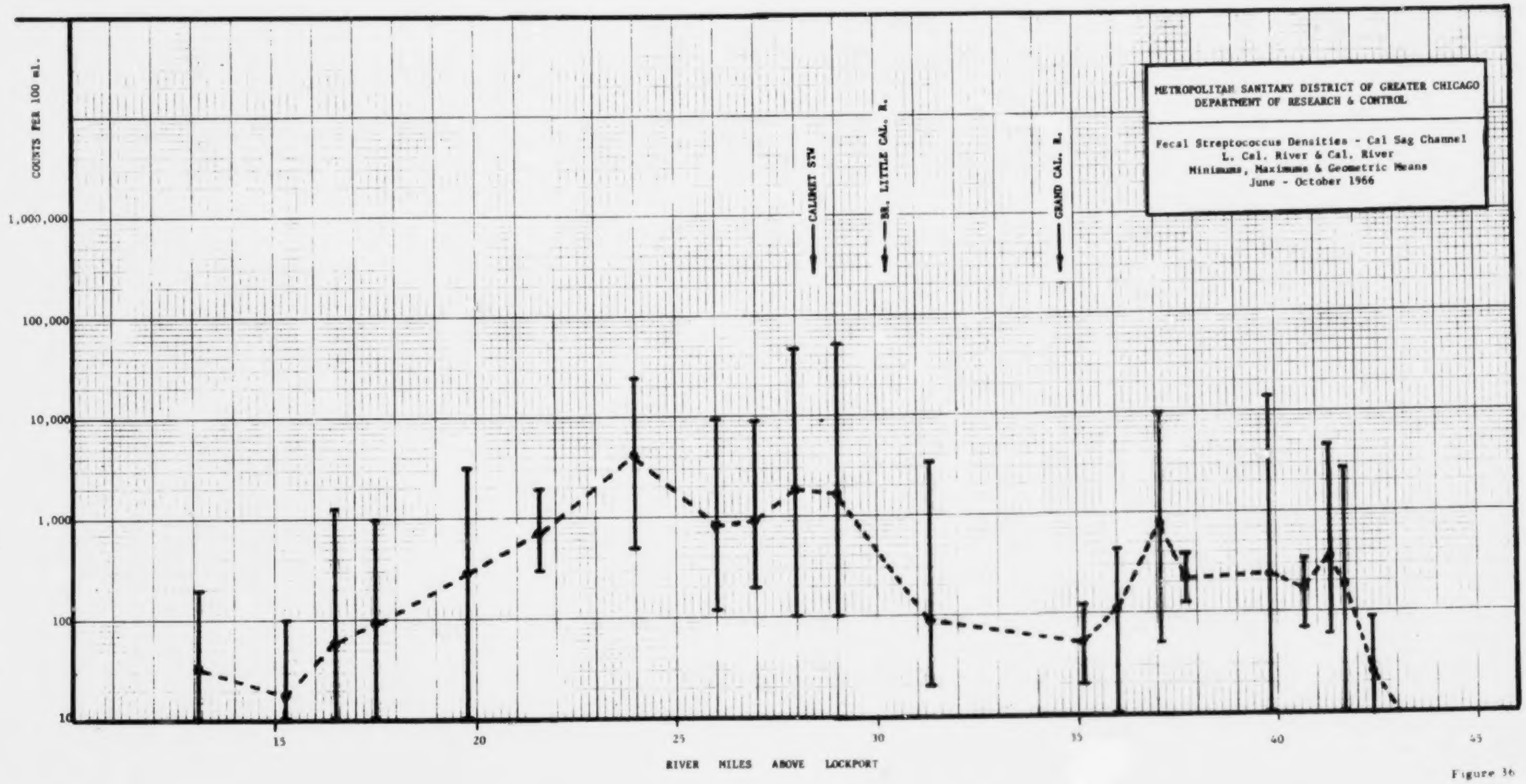
Figure 34



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL

FECAL COLIFORM DENSITIES
Cal. Sag. Channel, L. Cal. River & Cal. River
Minimums, Maximums & Geometric Means
June - October 1966

Figure 35



METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DEPARTMENT OF RESEARCH & CONTROL

Fecal Streptococcus Densities - Cal Sag Channel
L. Cal. River & Cal. River
Minimums, Maximums & Geometric Means
June - October 1966

Figure 36

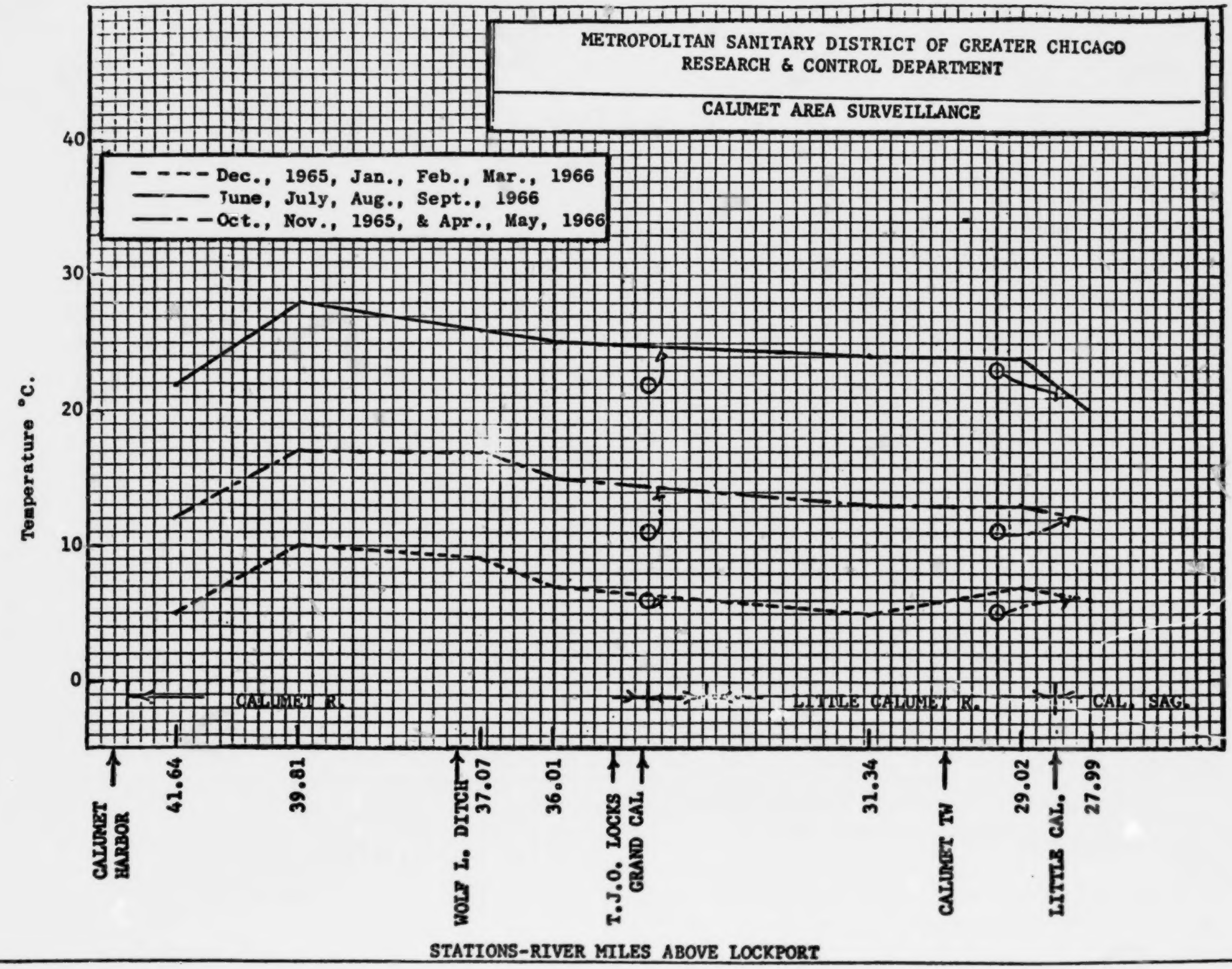


Figure 37 TEMPERATURE SEASONAL AVERAGES - CALUMET AREA - OCT. 1965 to OCT. 1966

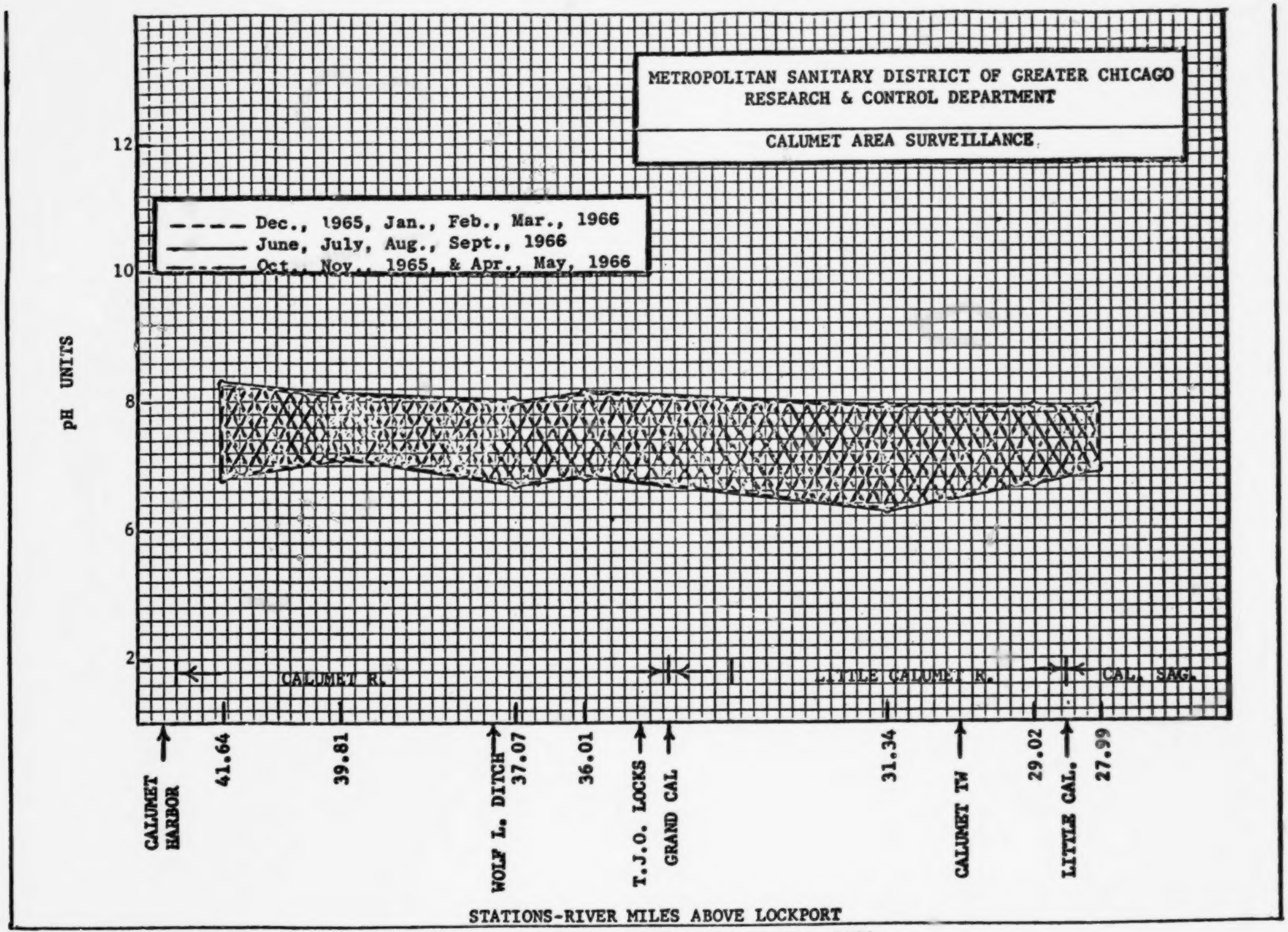


Figure 38 pH RANGES - CALUMET AREA.OCT. 1965 TO OCT. 1966

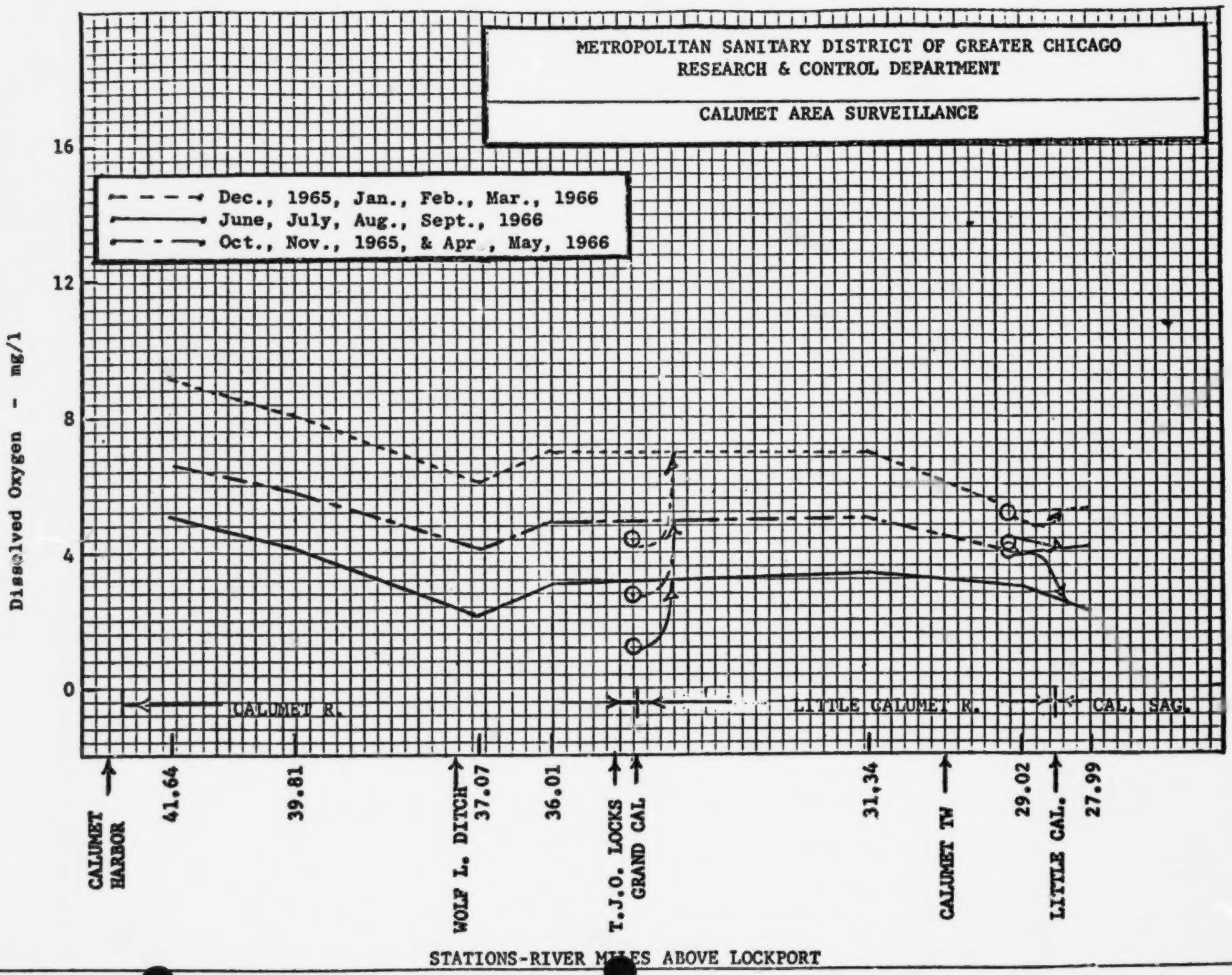


Figure 39 DISSOLVED OXYGEN SEASONAL AVERAGES - CALUMET AREA - OCT. 1965 to OCT. 1966

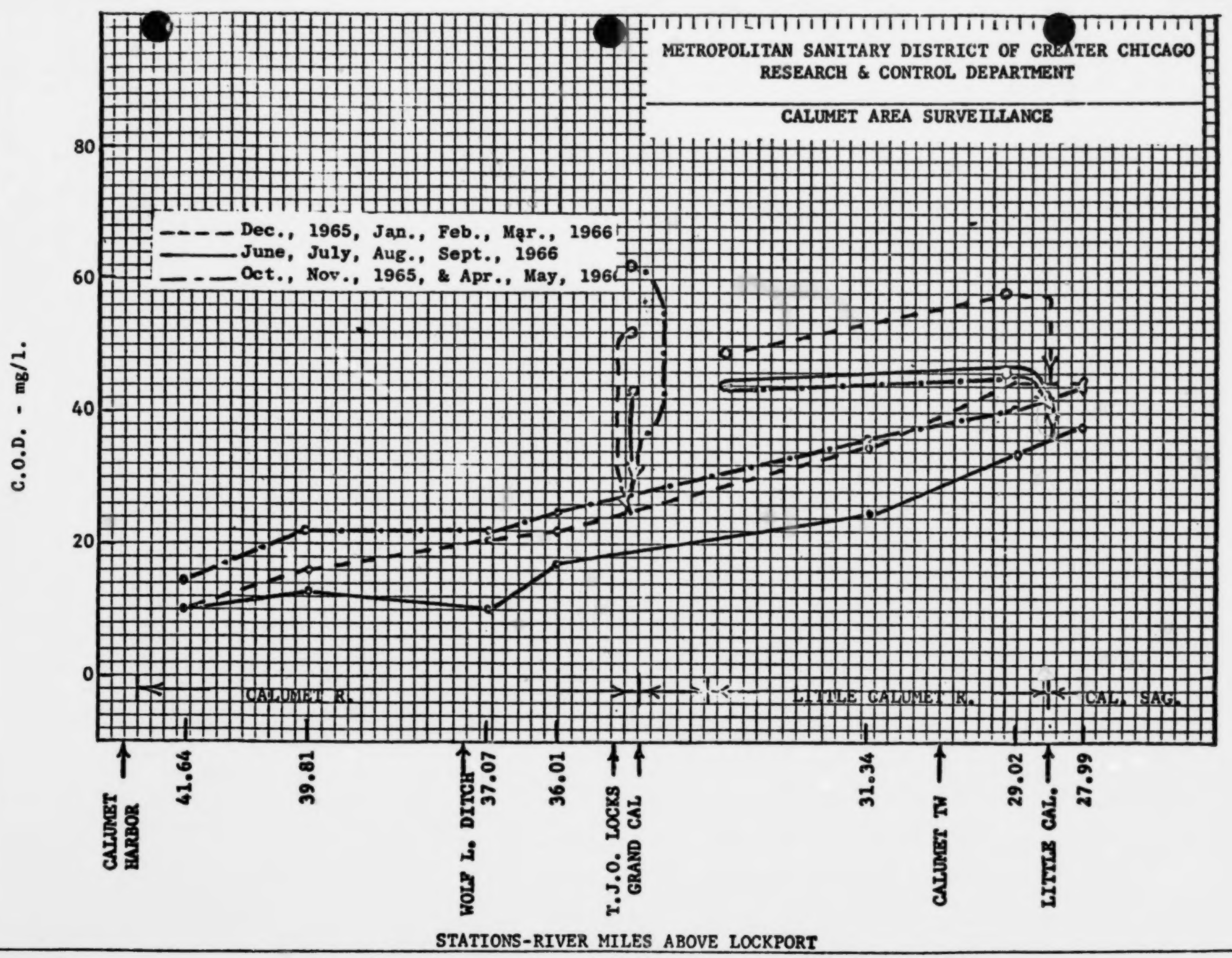


Figure 40 C.O.D. SEASONAL AVERAGES - CALUMET AREA - OCT. 1965 TO OCT. 1966

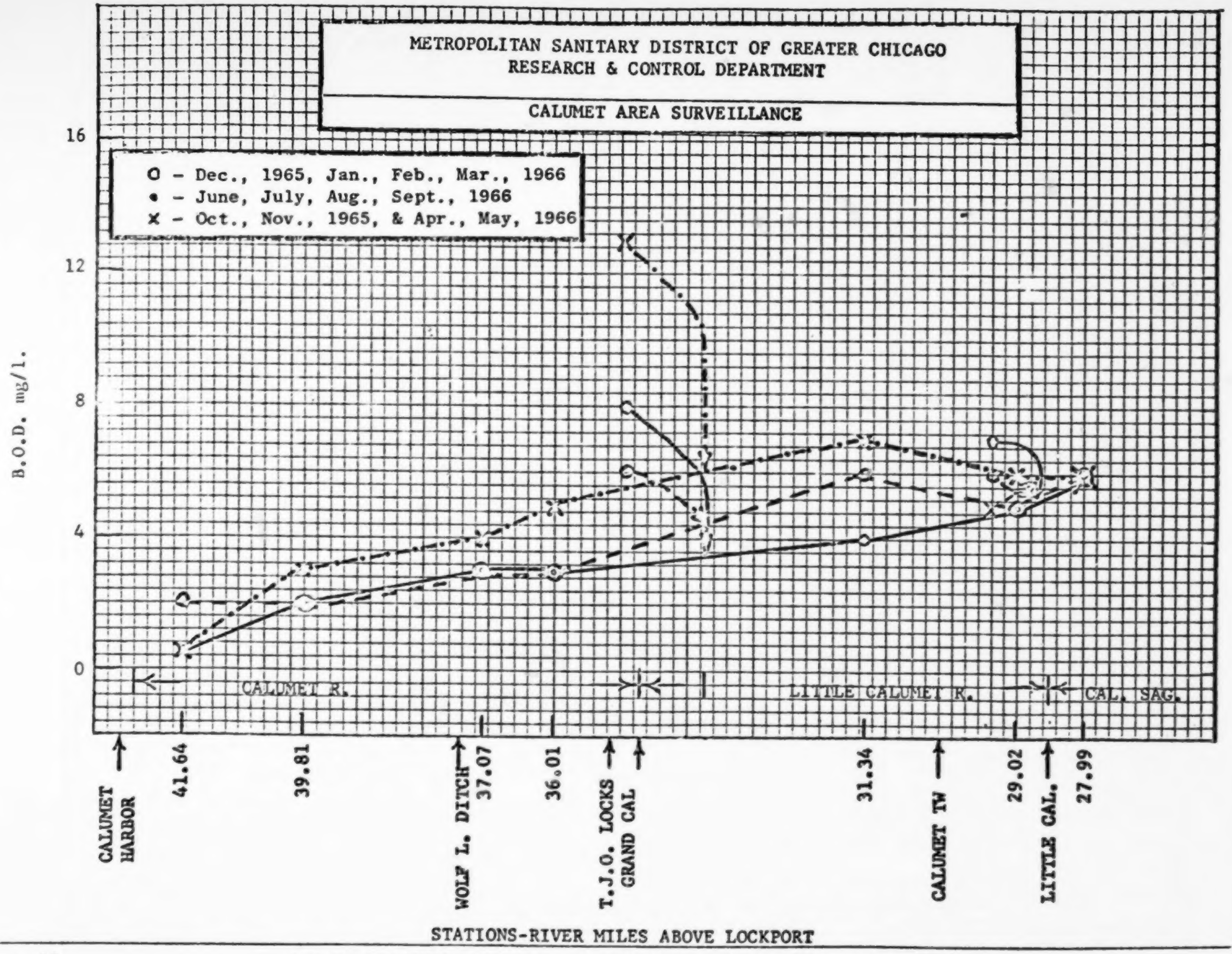


Figure 41 B.O.D. SEASONAL AVERAGES - CALUMET AREA OCT. 1965 - Oct. 1966

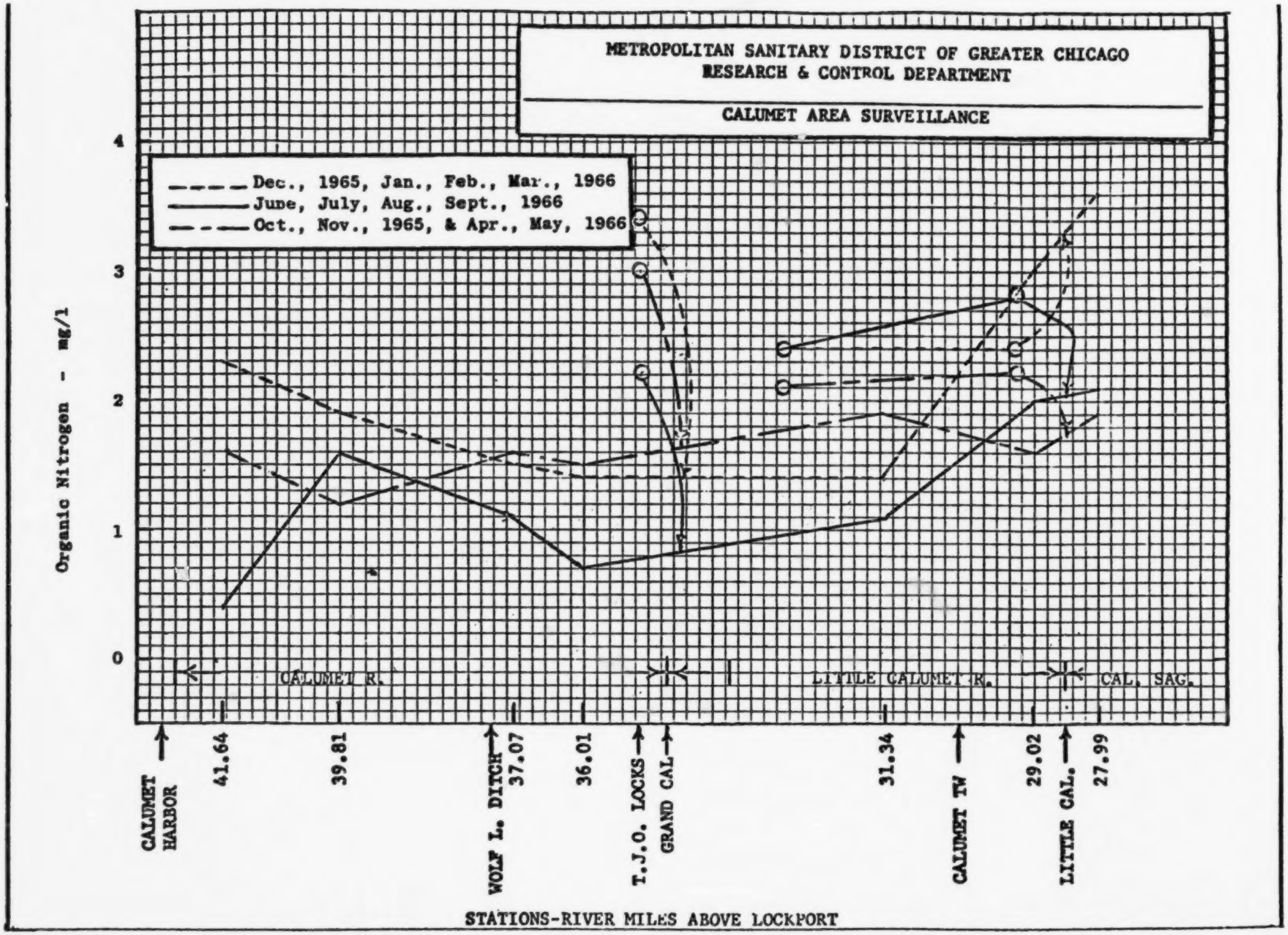


Figure 42 ORGANIC NITROGEN SEASONAL AVERAGES - CALUMET AREA - OCT. 1965 TO OCT. 1966

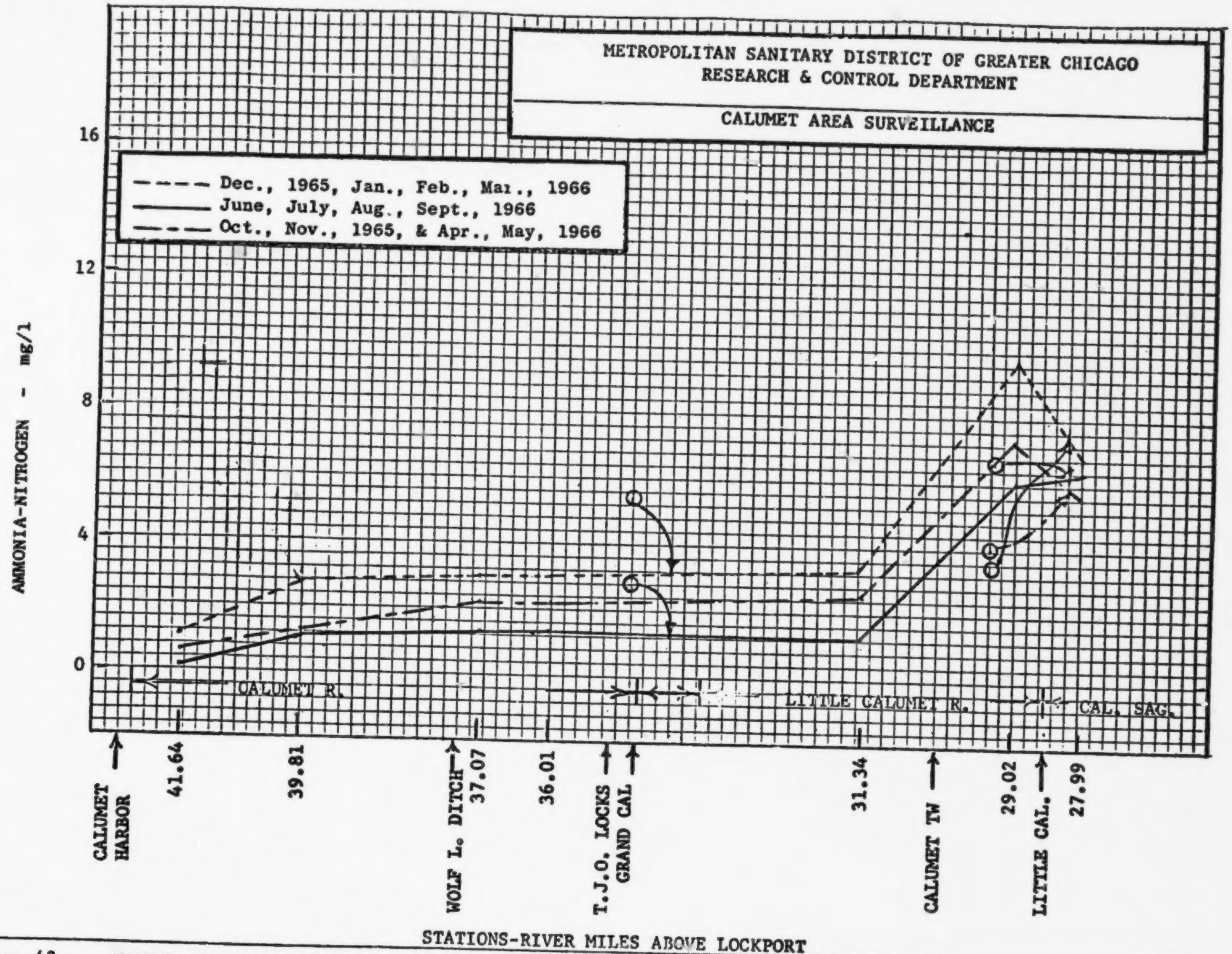


Figure 43 AMMONIA NITROGEN SEASONAL AVERAGES - CALUMET. AREA - OCT. 1965 TO OCT. 1966

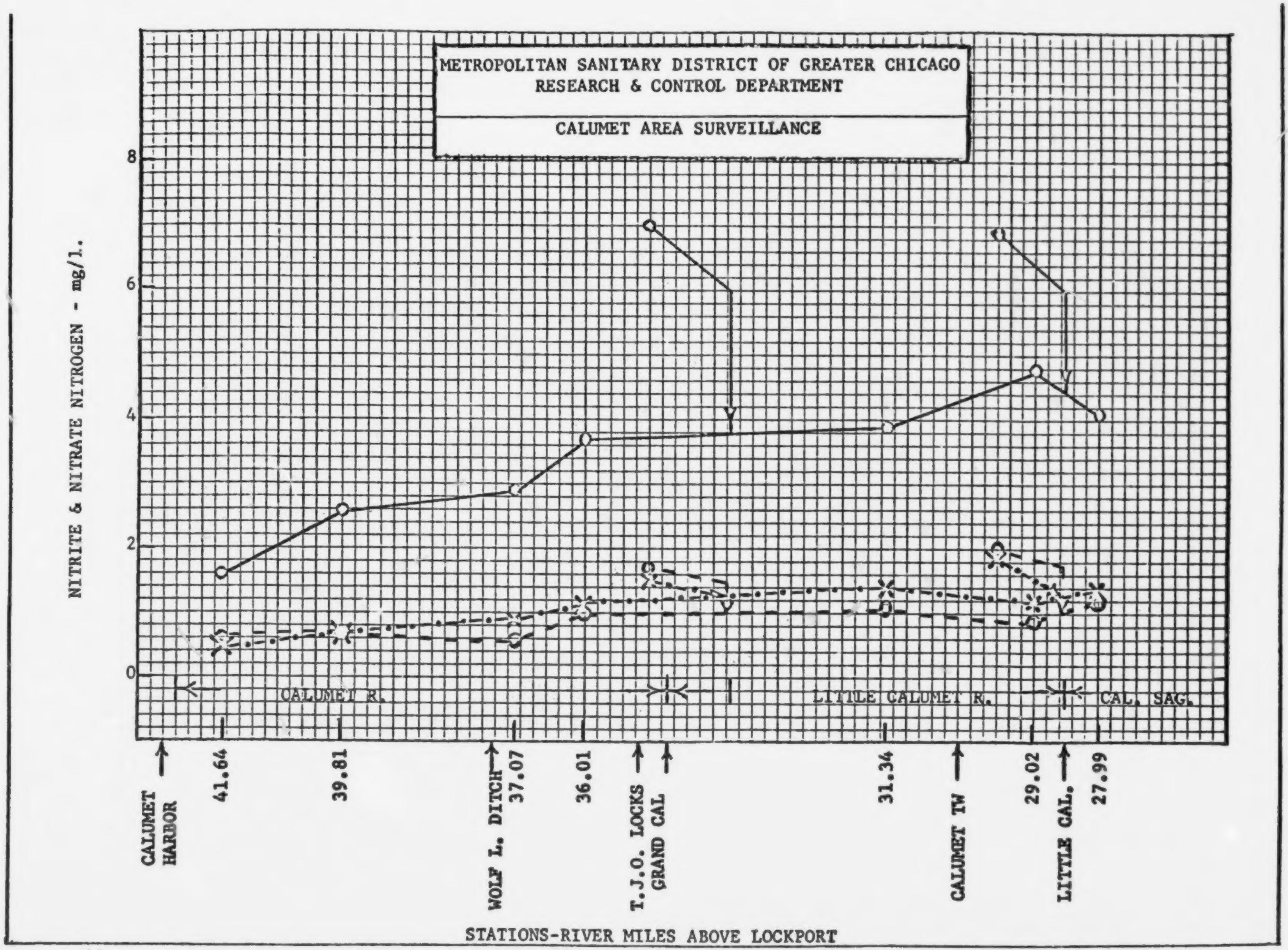


Figure 44 NITRITE & NITRATE NITROGEN SEASONAL AVERAGES - CALUMET AREA - OCT., 1965 TO OCT., 1966

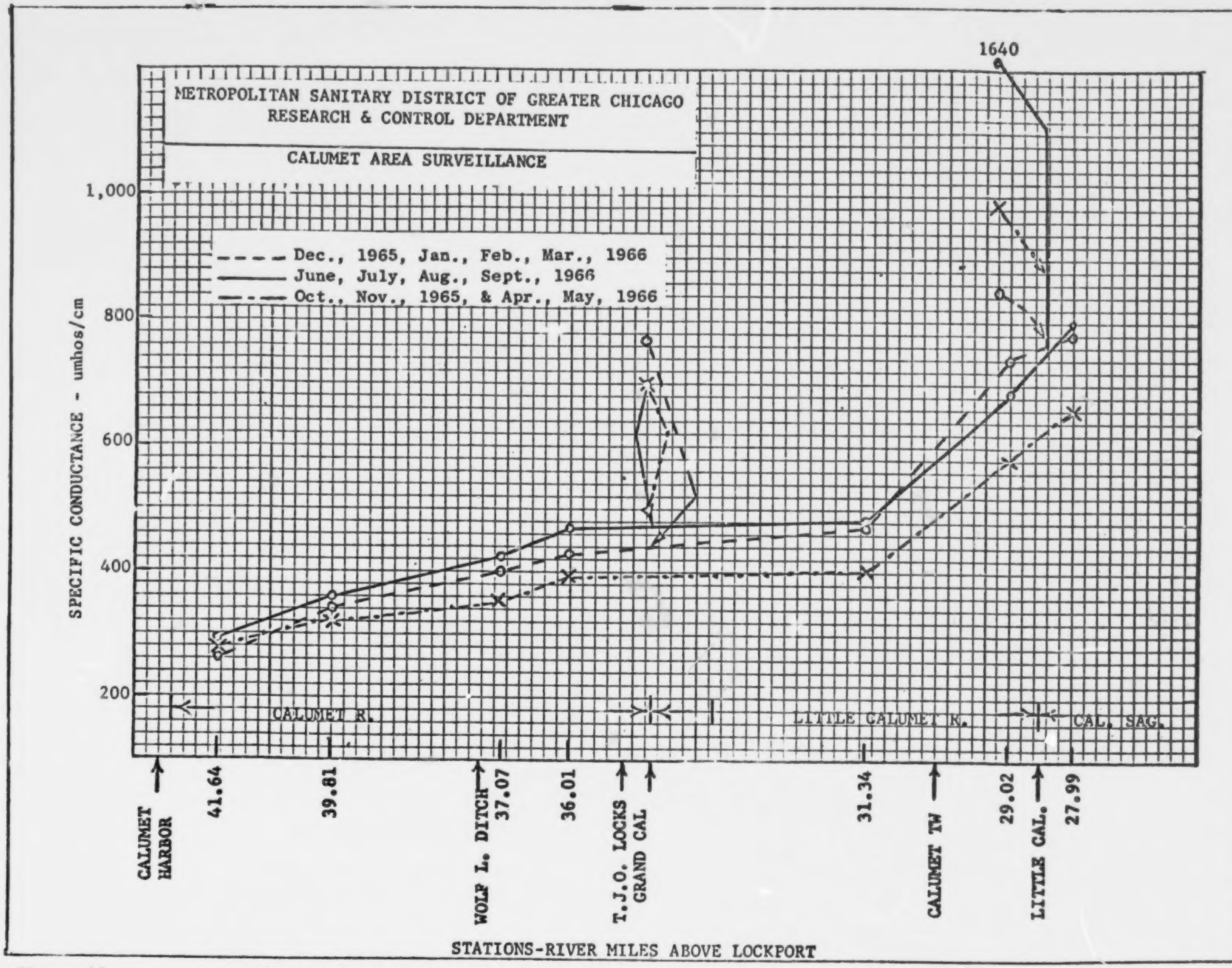


Figure 45

SPECIFIC CONDUCTANCE SEASONAL AVERAGES - CALUMET AREA - OCT. 1965 TO OCT. 1966

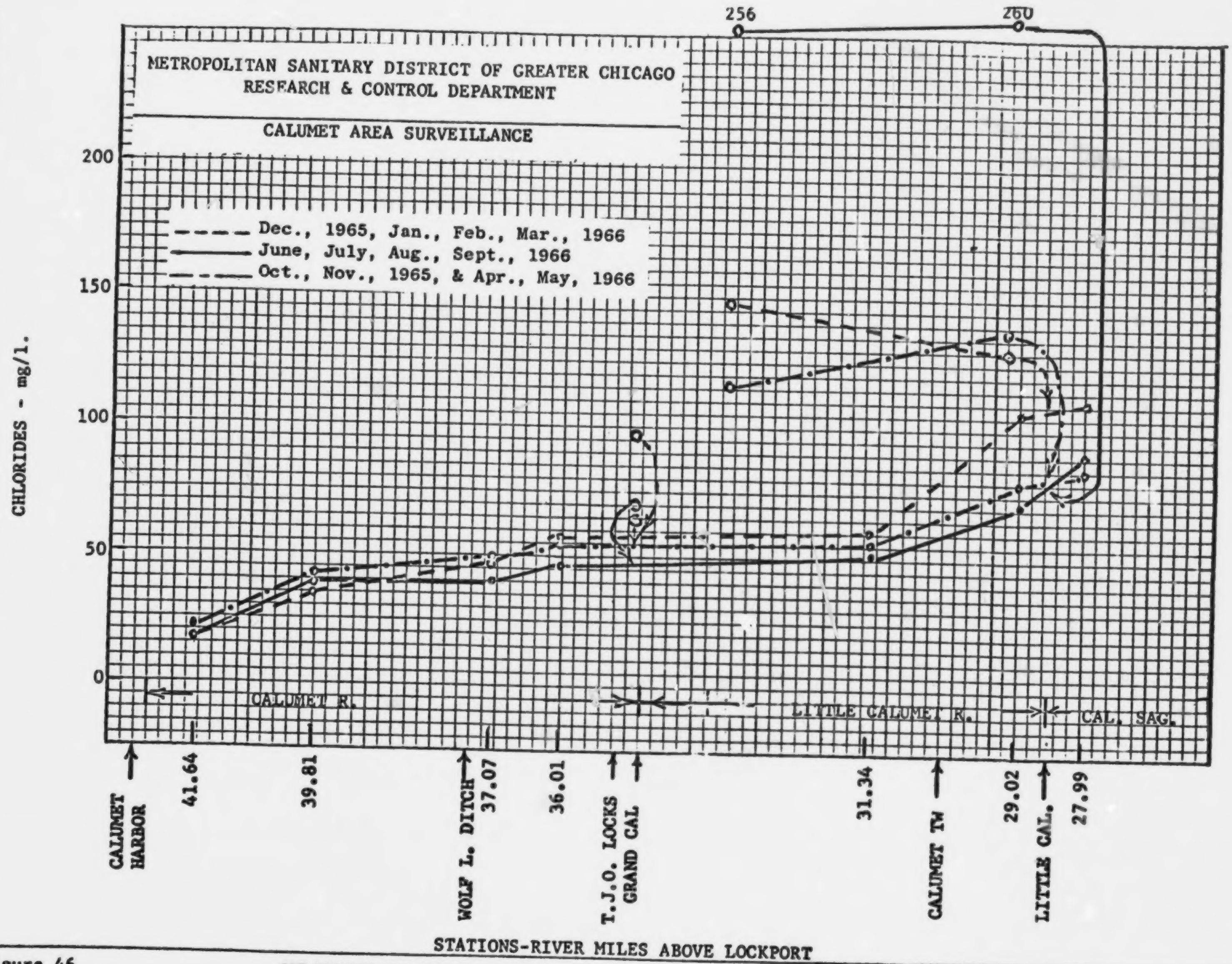


Figure 46

CHLORIDES SEASONAL AVERAGES CALUMET AREA - OCT. 1965 TO OCT. 1966

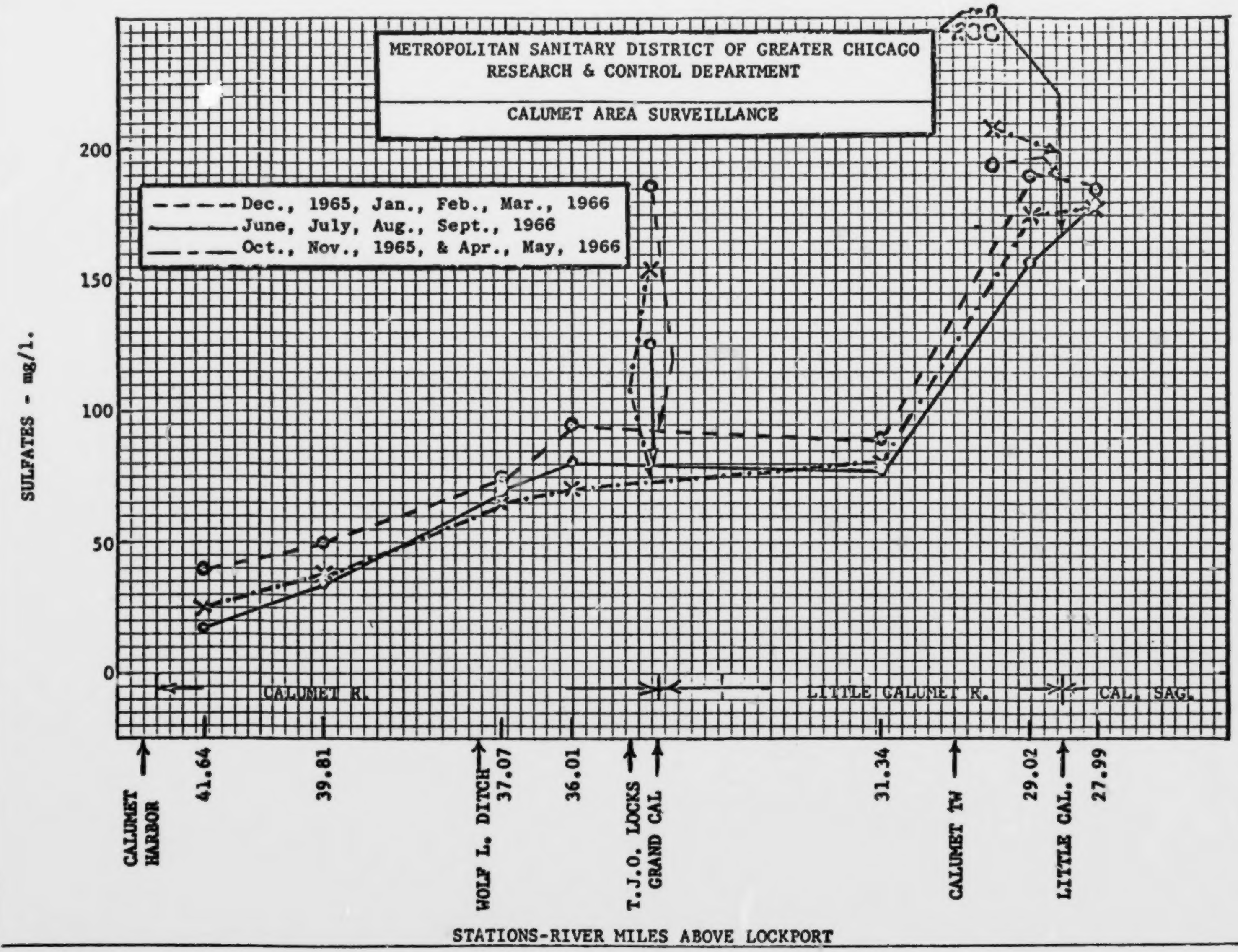


Figure 47

SULFATES - SEASONAL AVERAGES - CALUMET AREA - OCT. 1965 TO OCT. 1966

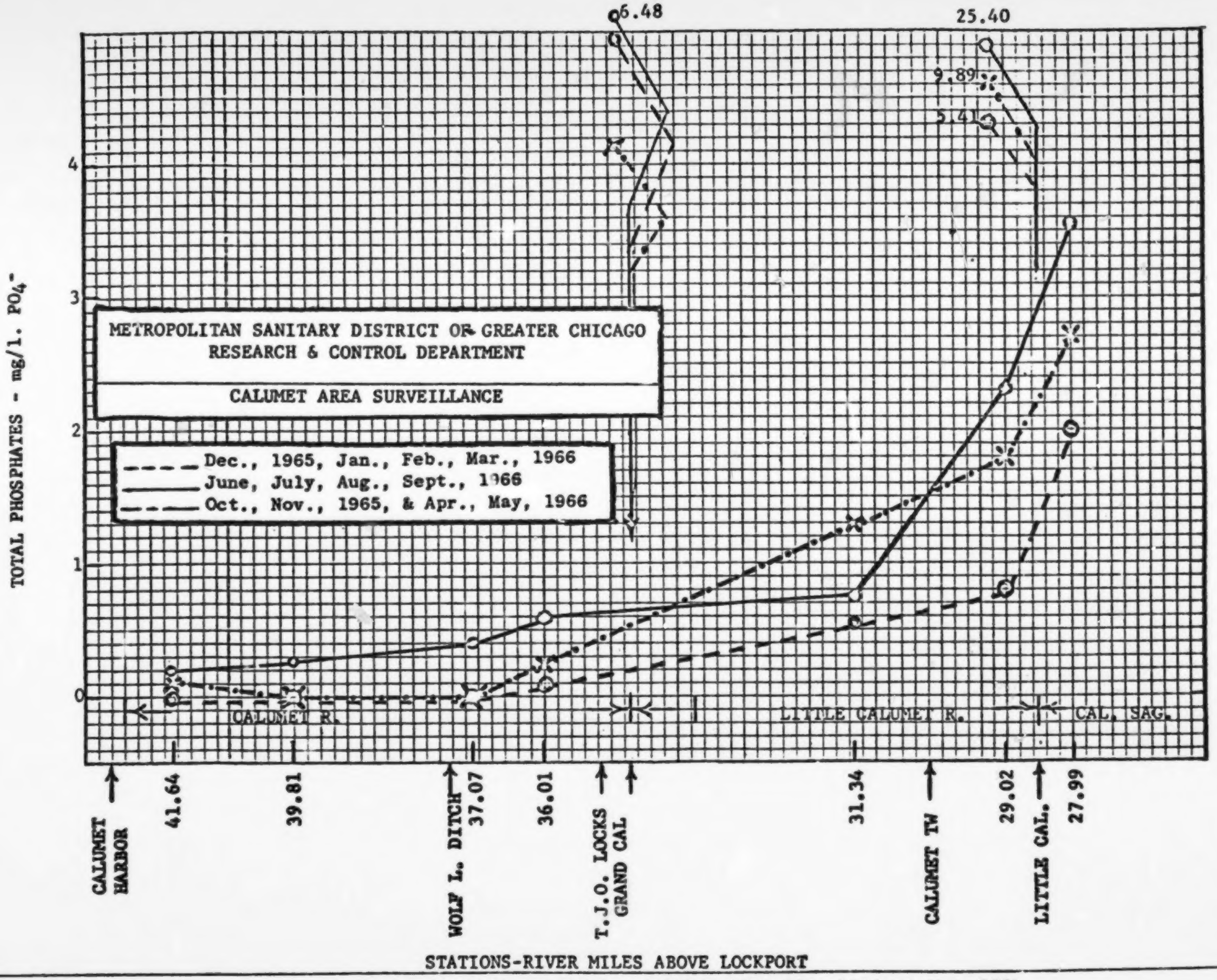


Figure 48 TOTAL PHOSPHATES SEASONAL AVERAGES - CALUMET AREA OCT. 1965 TO OCT. 1966

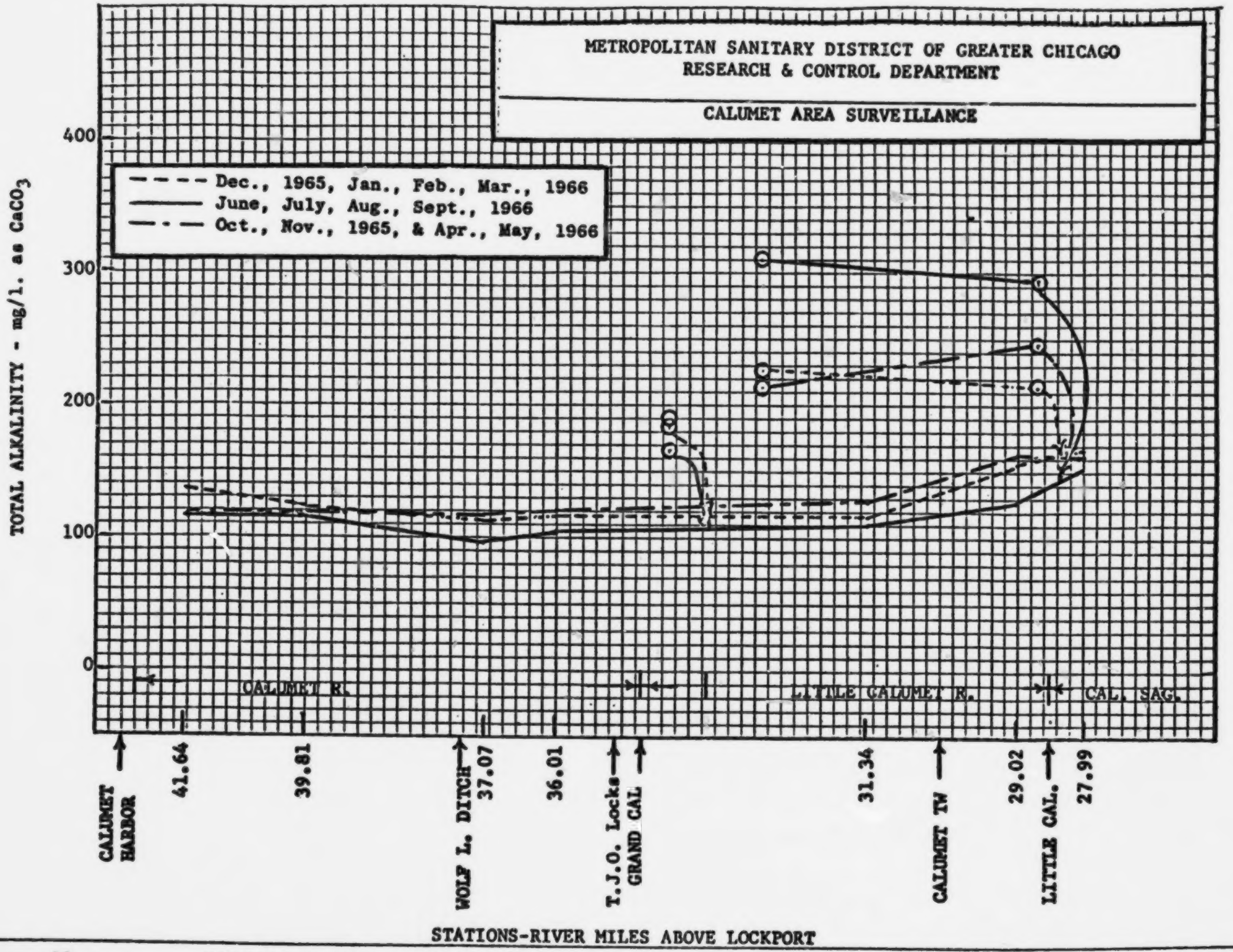


Figure 49 TOTAL ALKALINITY SEASONAL AVERAGES CALUMET AREA - OCT. 1965 TO OCT. 1966

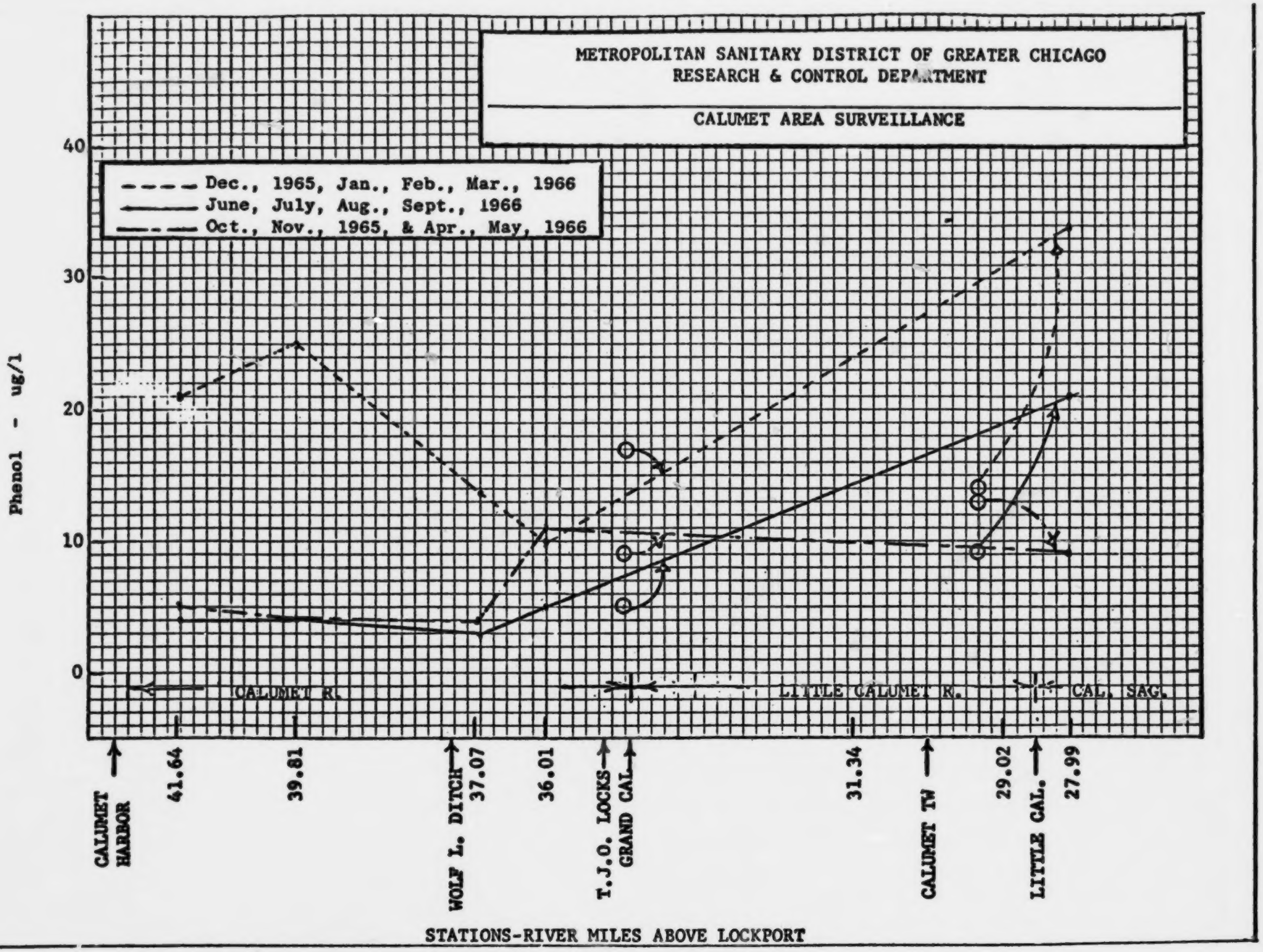


Figure 50 PHENOL SEASONAL AVERAGES - CALUMET AREA - OCT. 1965 TO OCT. 1966

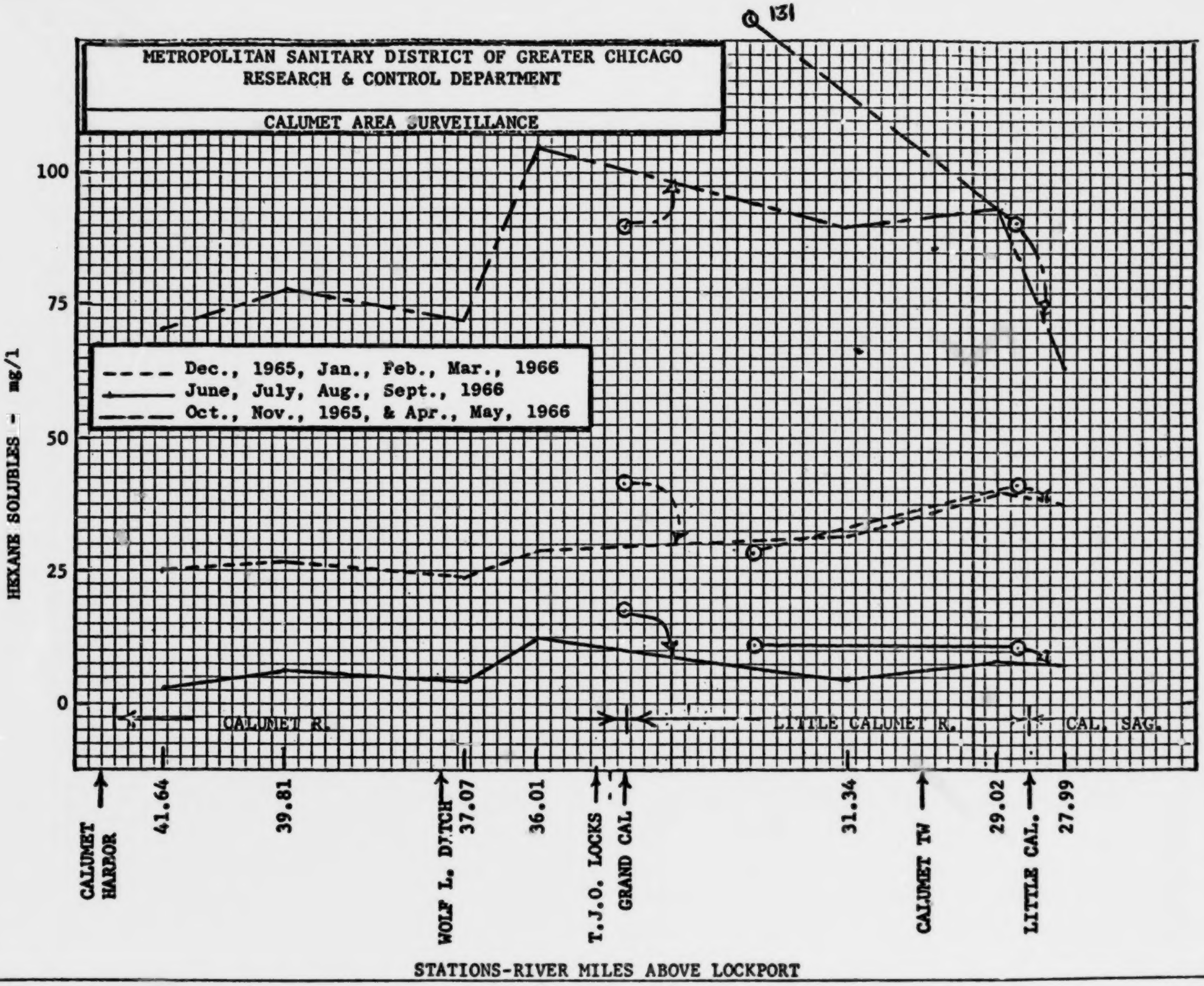


Figure 51 HEXANE SOLUBLES SEASONAL AVERAGES - CALUMET AREA - OCT. 1965 TO OCT. 1966

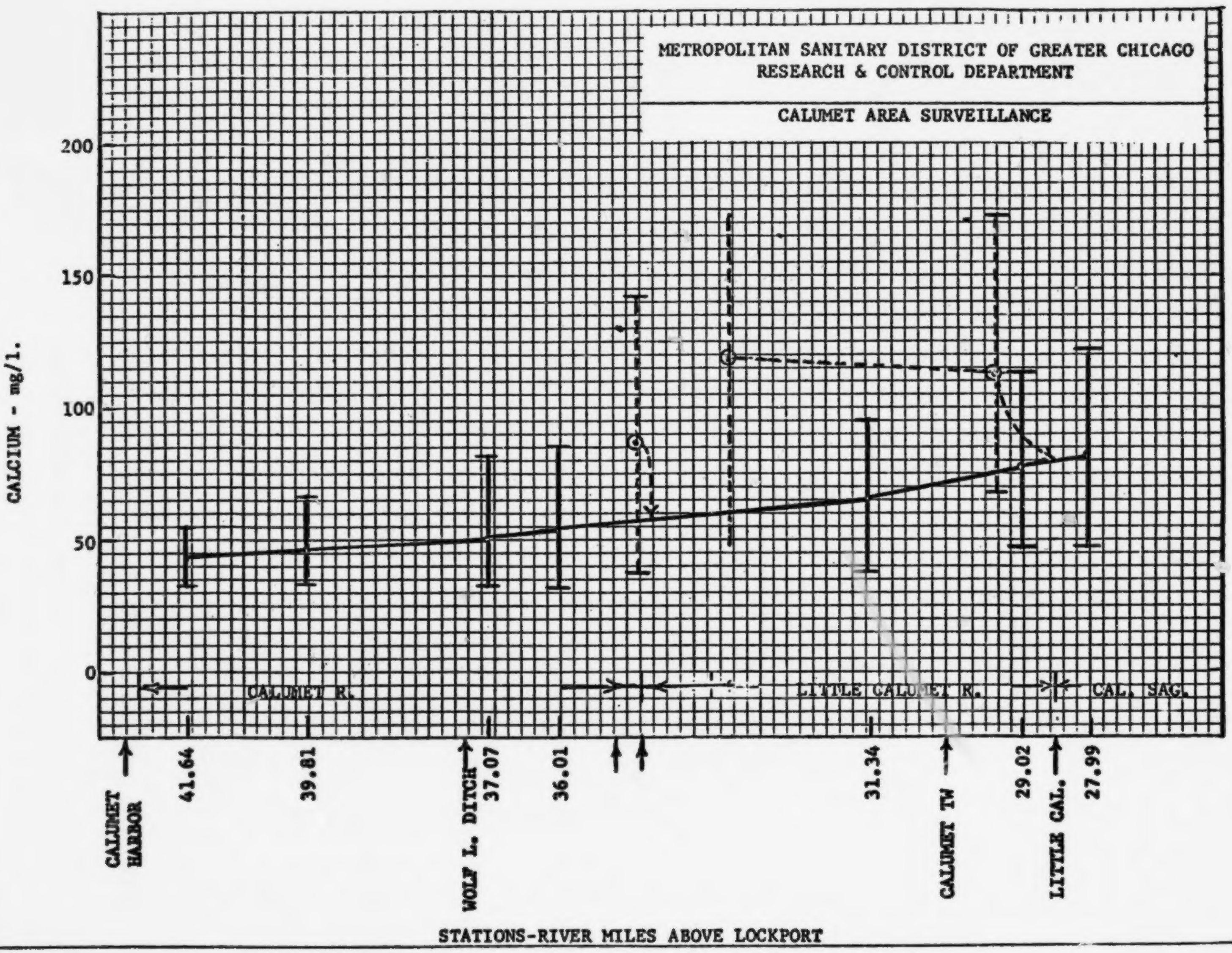


Figure 52 CALCIUM LEVELS - CALUMET AREA - OCT. 1965 TO OCT. 1966

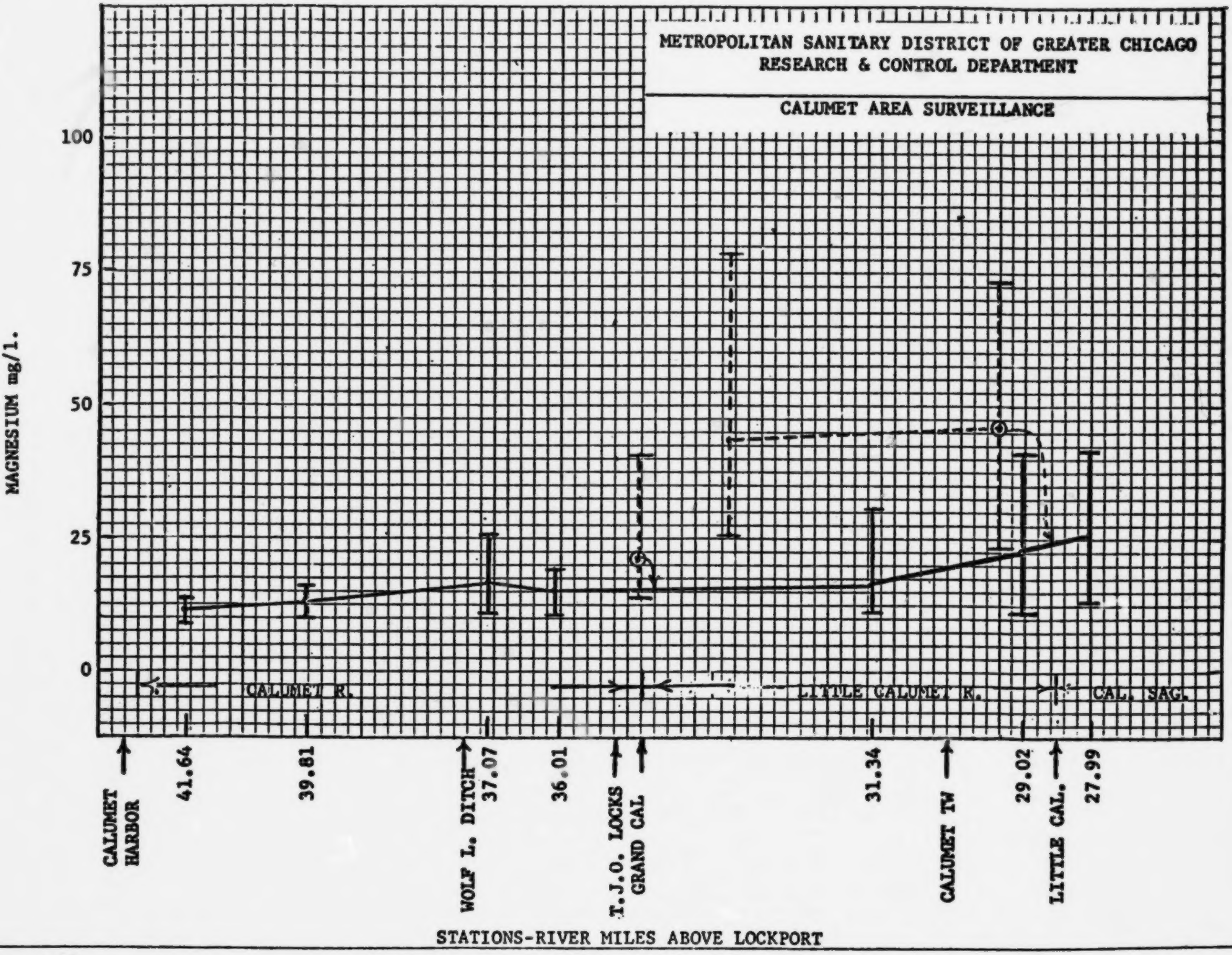


Figure 53

MAGNESIUM LEVELS CALUMET AREA - OCT. 1965 TO OCT. 1966

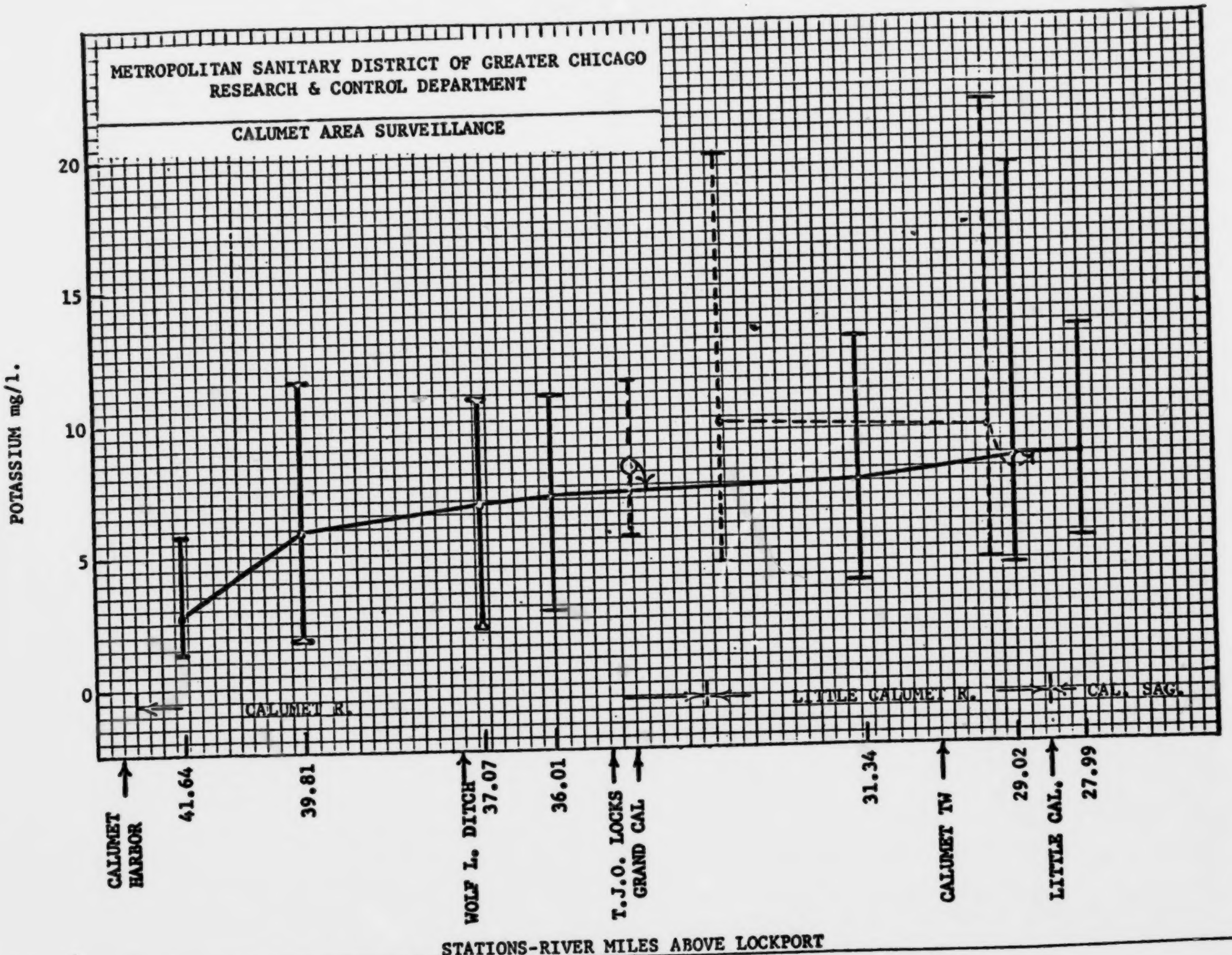


Figure 54 POTASSIUM LEVELS - CALUMET AREA - OCT. 1965 TO OCT. 1966

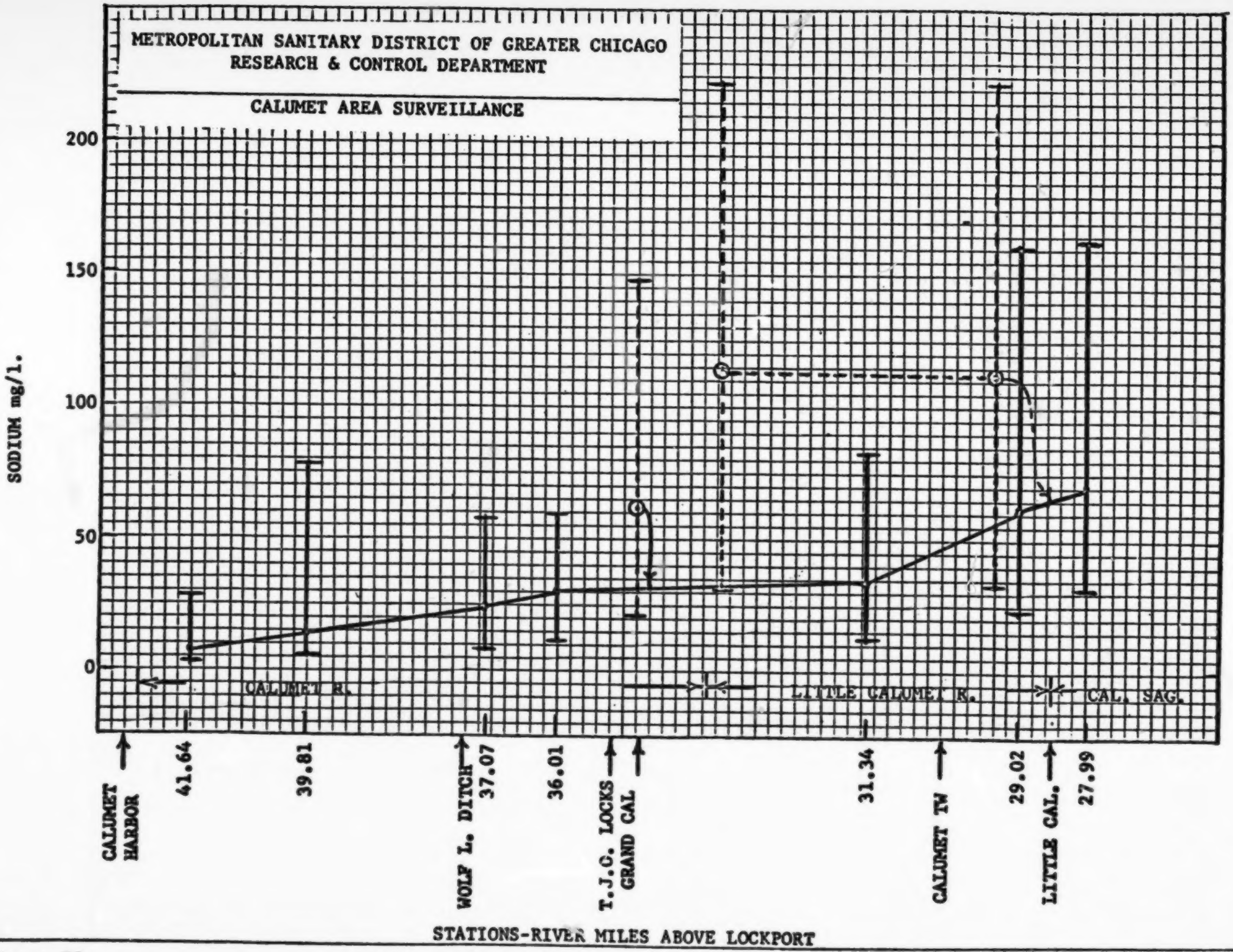


Figure 55

SODIUM LEVELS - CALUMET AREA - OCT. 1965 TO OCT. 1966

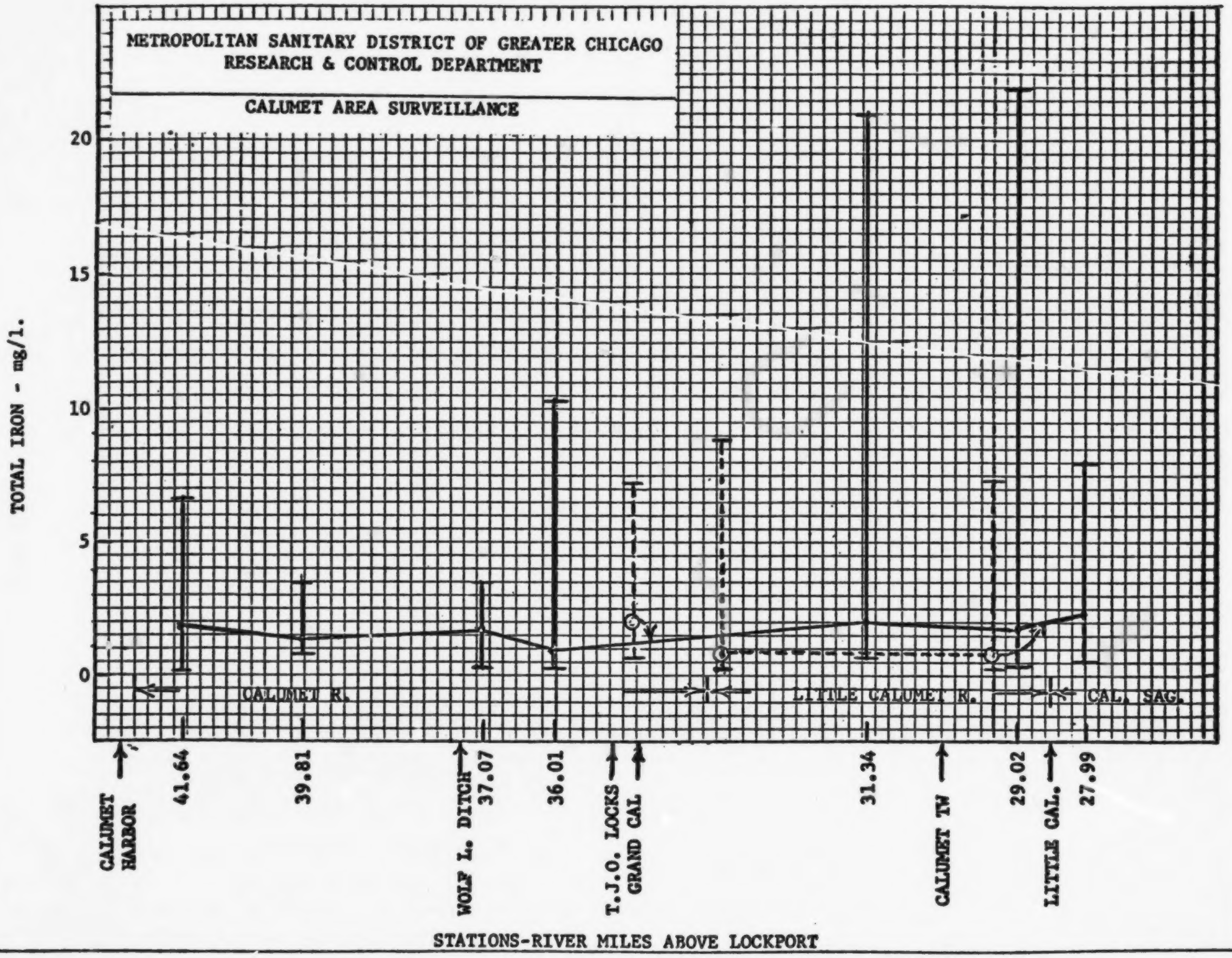


Figure 56 TOTAL IRON LEVELS - CALUMET AREA - OCT. 1965 TO OCT. 1966

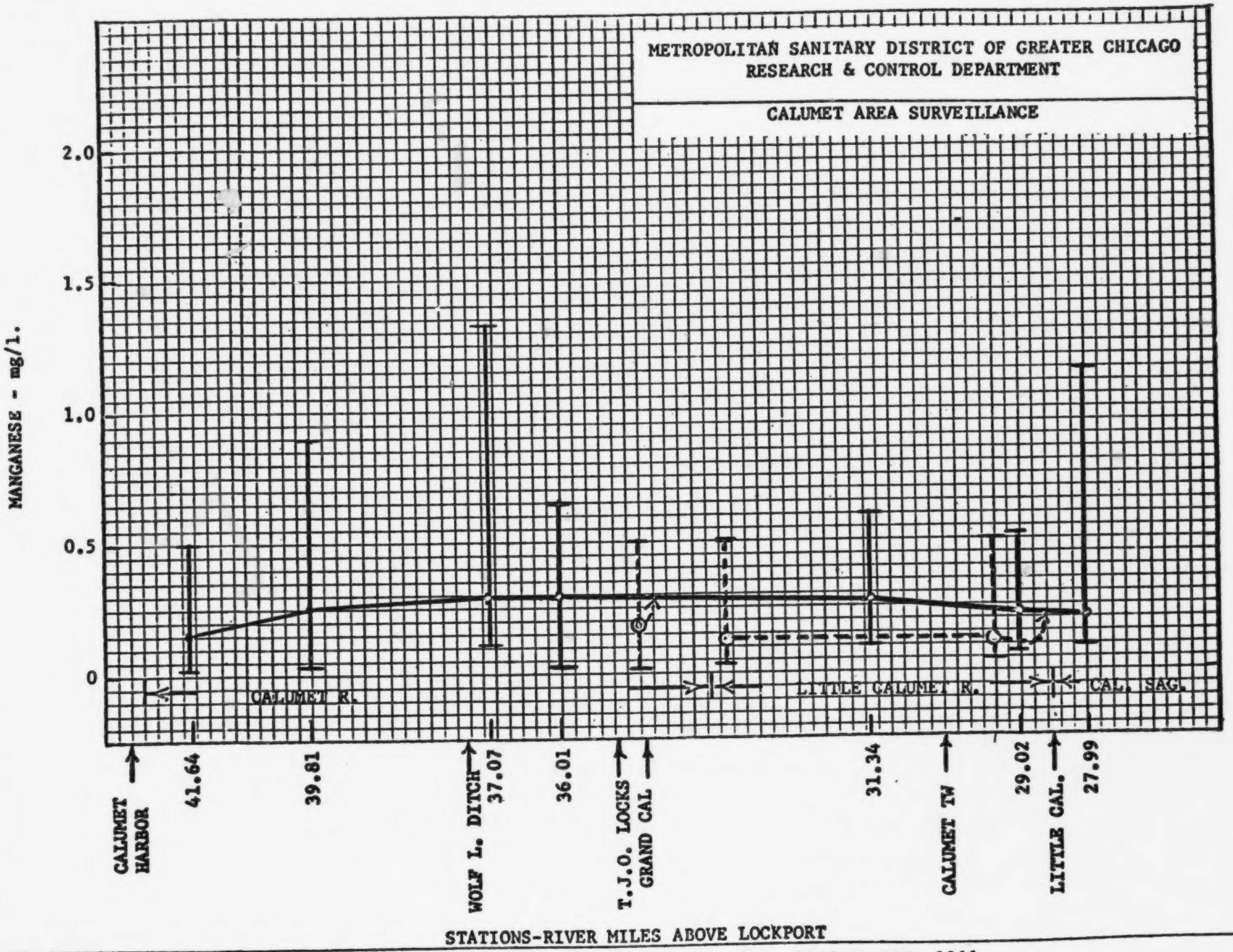


Figure 57

MANGANESE LEVELS - CALUMET AREA - OCT. 1965 TO OCT. 1966

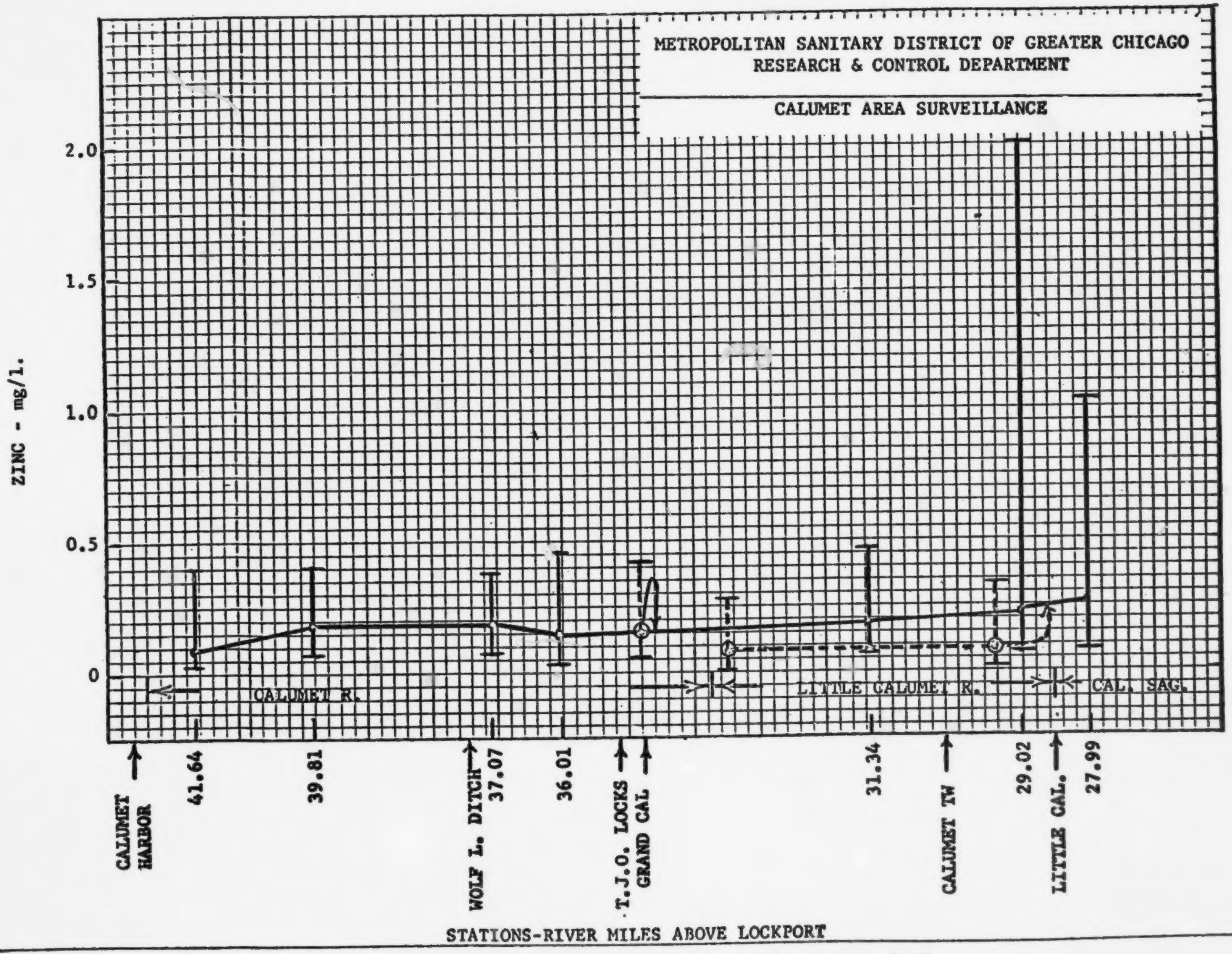


Figure 58

ZINC LEVELS - CALUMET·AREA - OCT. 1965 TO OCT. 1966

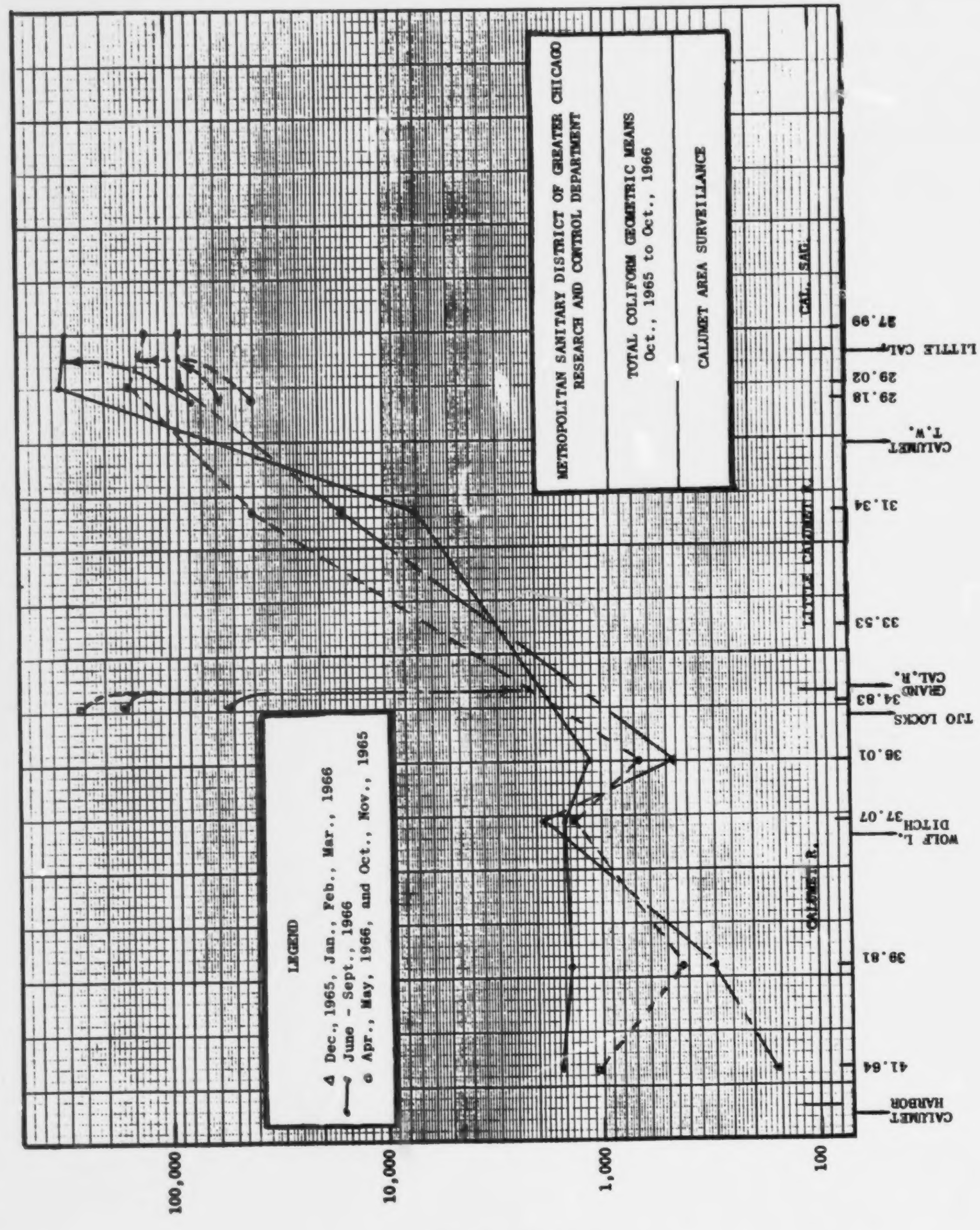

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH AND CONTROL DEPARTMENT
TOTAL COLIFORM GEOMETRIC MEANS
Oct., 1965 to Oct., 1966
CALUMET AREA SURVEILLANCE
LEGEND
Δ Dec., 1965, Jan., Feb., Mar., 1966
June - Sept., 1966
o Apr., May, 1966, and Oct., Nov., 1965
COUNTS per 100 ml.
100,000
10,000
1,000
100
CALUMET HARBOR
41.64
39.81
CALUMET R.
WOLF L. DITCH
37.07
36.01
TJO LOCKS
34.83
GRAND CAL.R.
33.53
LITTLE CALUMET R.
31.34
CALUMET T.W.
29.18
29.02
LITTLE CAL.
27.99
CAL. SAG.

Figure 59

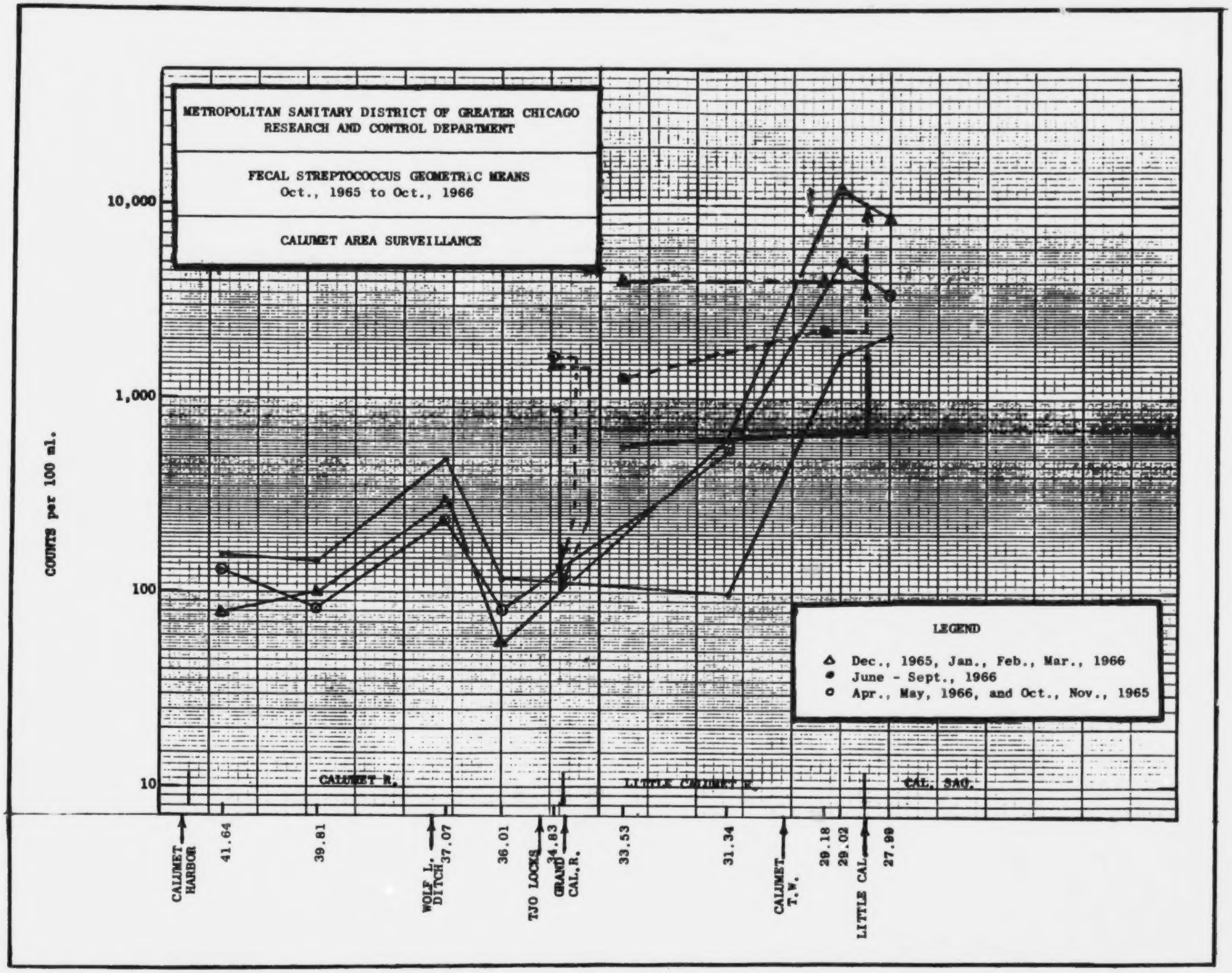

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
RESEARCH AND CONTROL DEPARTMENT
FECAL STREPTOCOCCUS GEOMETRIC MEANS
Oct., 1965 to Oct., 1966
CALUMET AREA SURVEILLANCE
COUNTS per 100 ml.
10,000
1,000
100
10
LEGEND
△ Dec., 1965, Jan., Feb., Mar., 1966
● June - Sept., 1966
○ Apr., May, 1966, and Oct., Nov., 1965
CALUMET R.
LITTLE CALUMET R.
CAL. SAG.
CALUMET HARBOR
41.64
39.81
WOLF L. DITCH
37.07
36.01
TJO LOCKS
34.83
GRAND CAL. R.
33.53
31.34
CALUMET T.W.
29.18
29.02
LITTLE CAL.
27.99

Figure 60

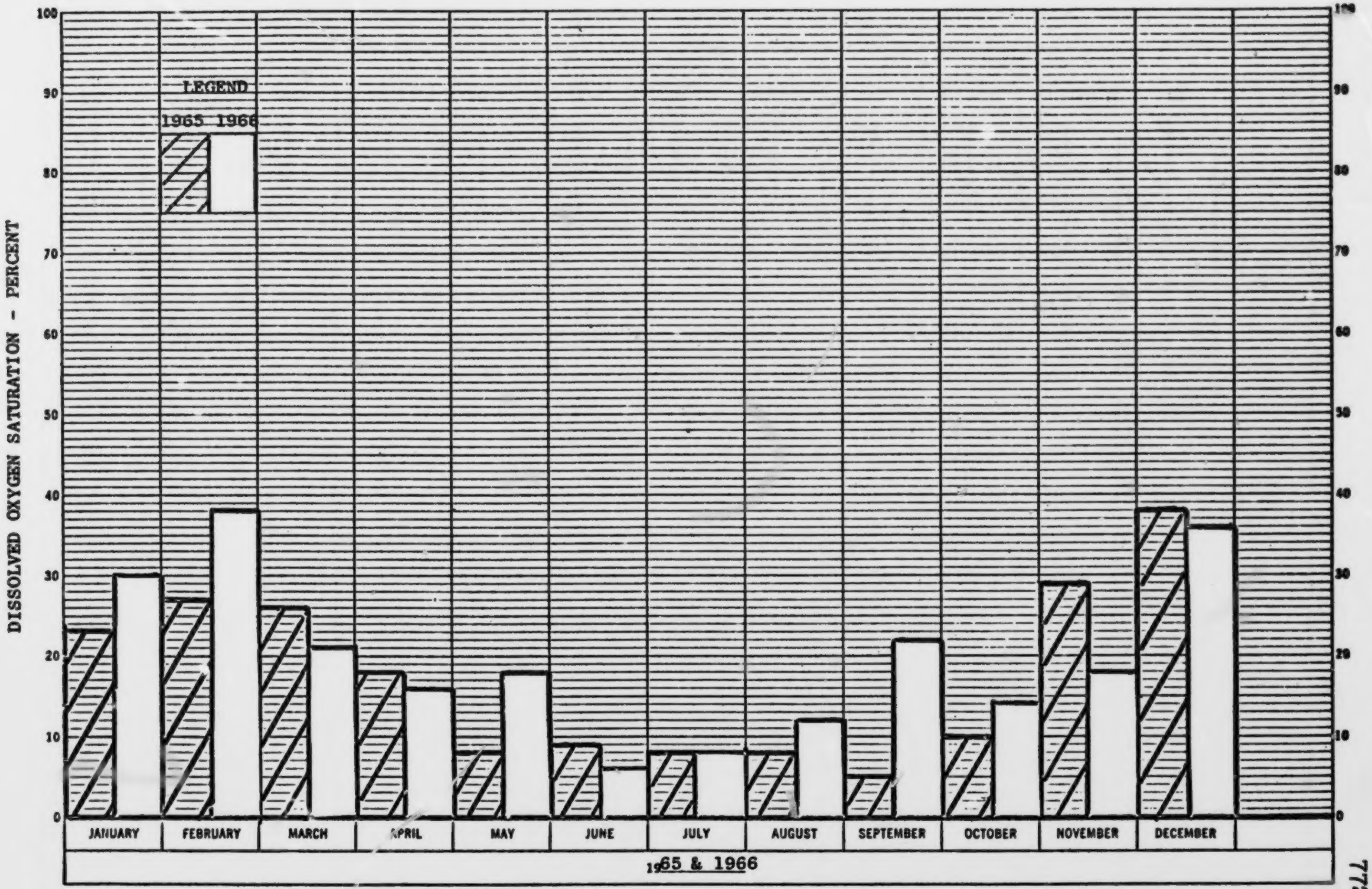


Figure Monthly Mean Dissolved Oxygen Saturation Levels - Sanitary & Ship Canal at Lemont

Fig. 61

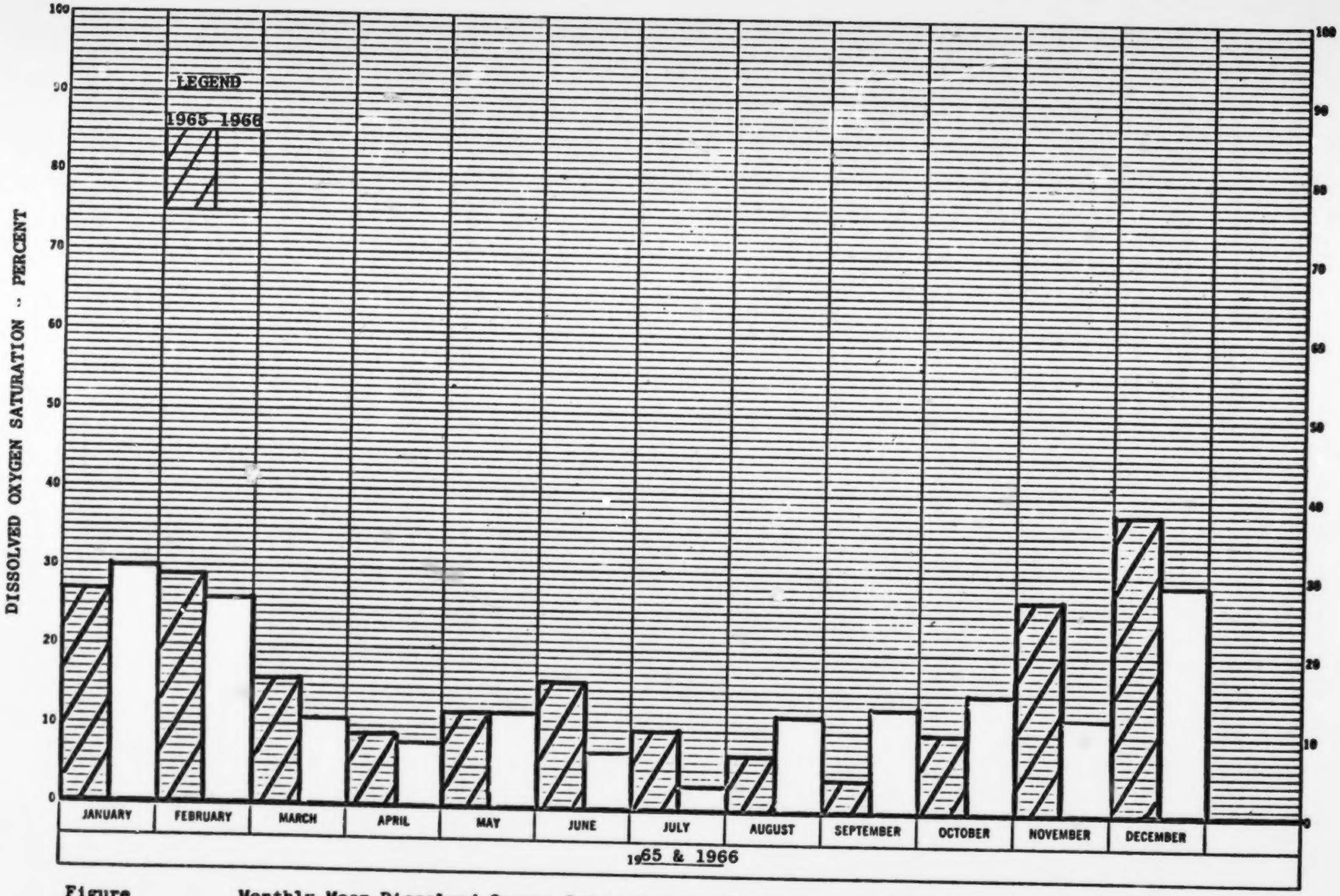


Figure Monthly Mean Dissolved Oxygen Saturation Levels - Sanitary & Ship Canal at Lockport

Fig. 62

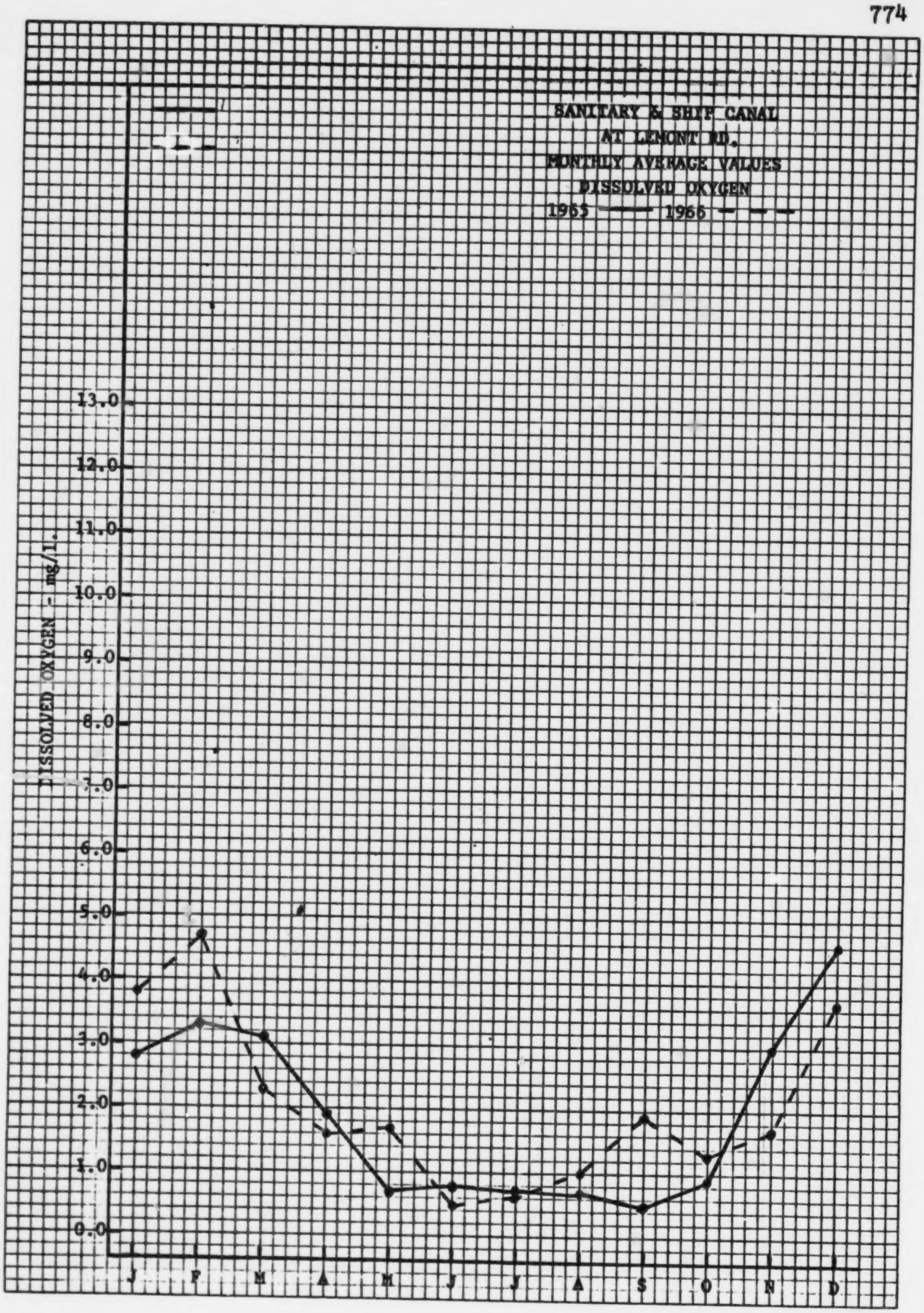

SANITARY & SHIP CANAL
AT LEMONT RD.
MONTHLY AVERAGE VALUES
DISSOLVED OXYGEN
1965 —— 1966 – – –
DISSOLVED OXYGEN - mg/1.
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 63

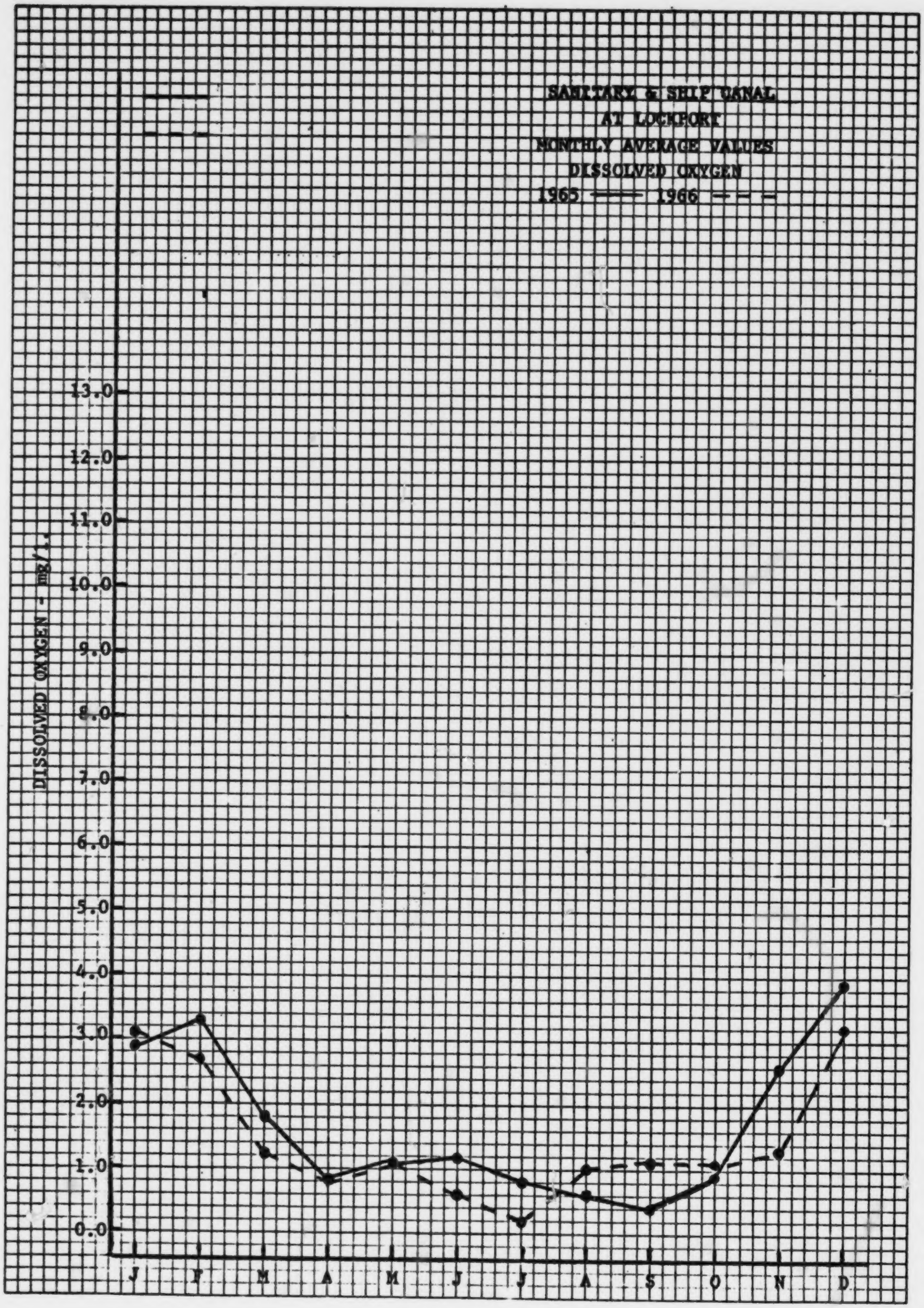

SANITARY & SHIP CANAL
AT LOCKPORT
MONTHLY AVERAGE VALUES
DISSOLVED OXYGEN
1965 —— 1966 — — —
DISSOLVED OXYGEN - mg/l.
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 64

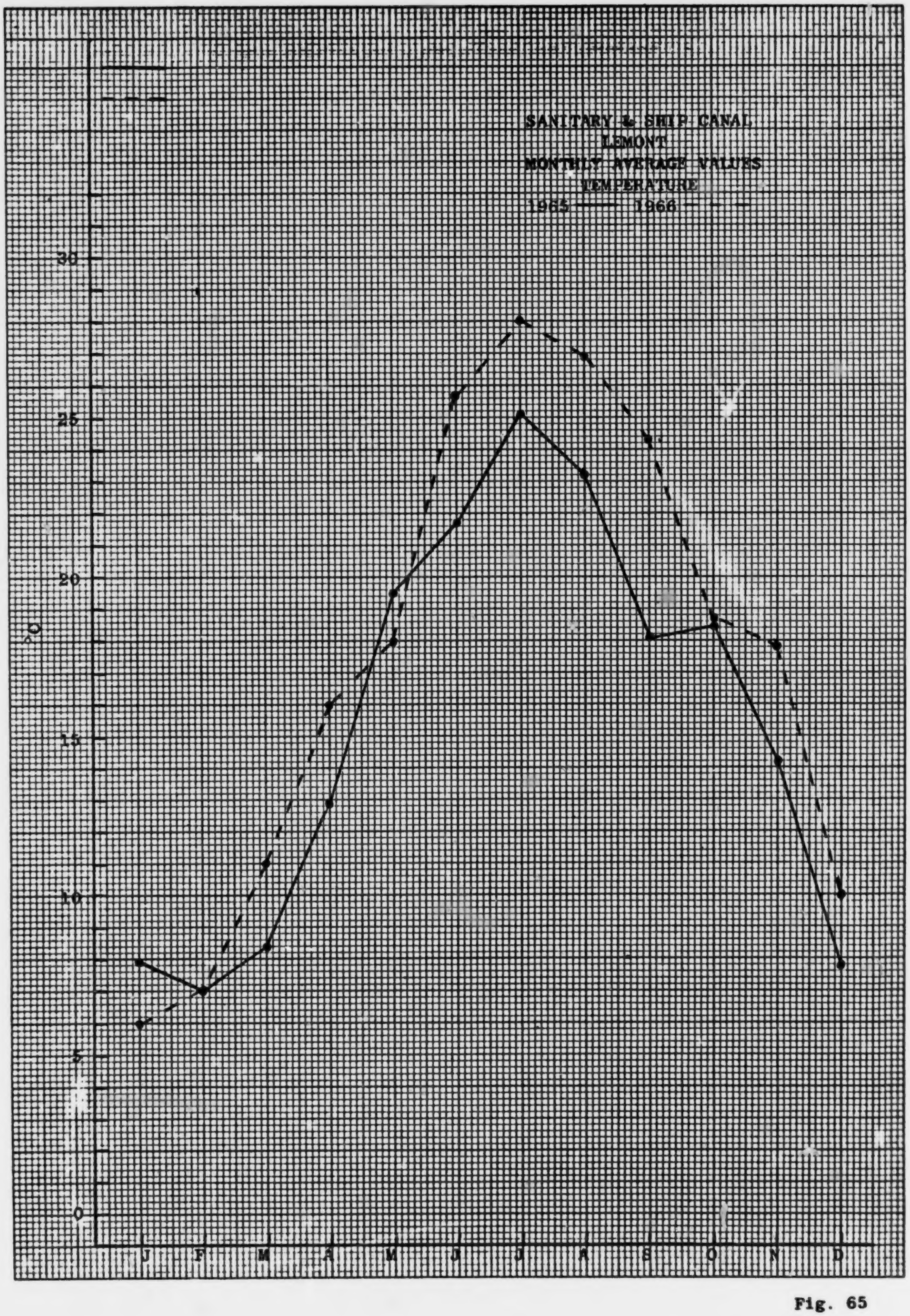

SANITARY & SHIP CANAL
LEMONT
MONTHLY AVERAGE VALUES
TEMPERATURE
1965
1966
°C
30
25
20
15
10
5
0
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 65

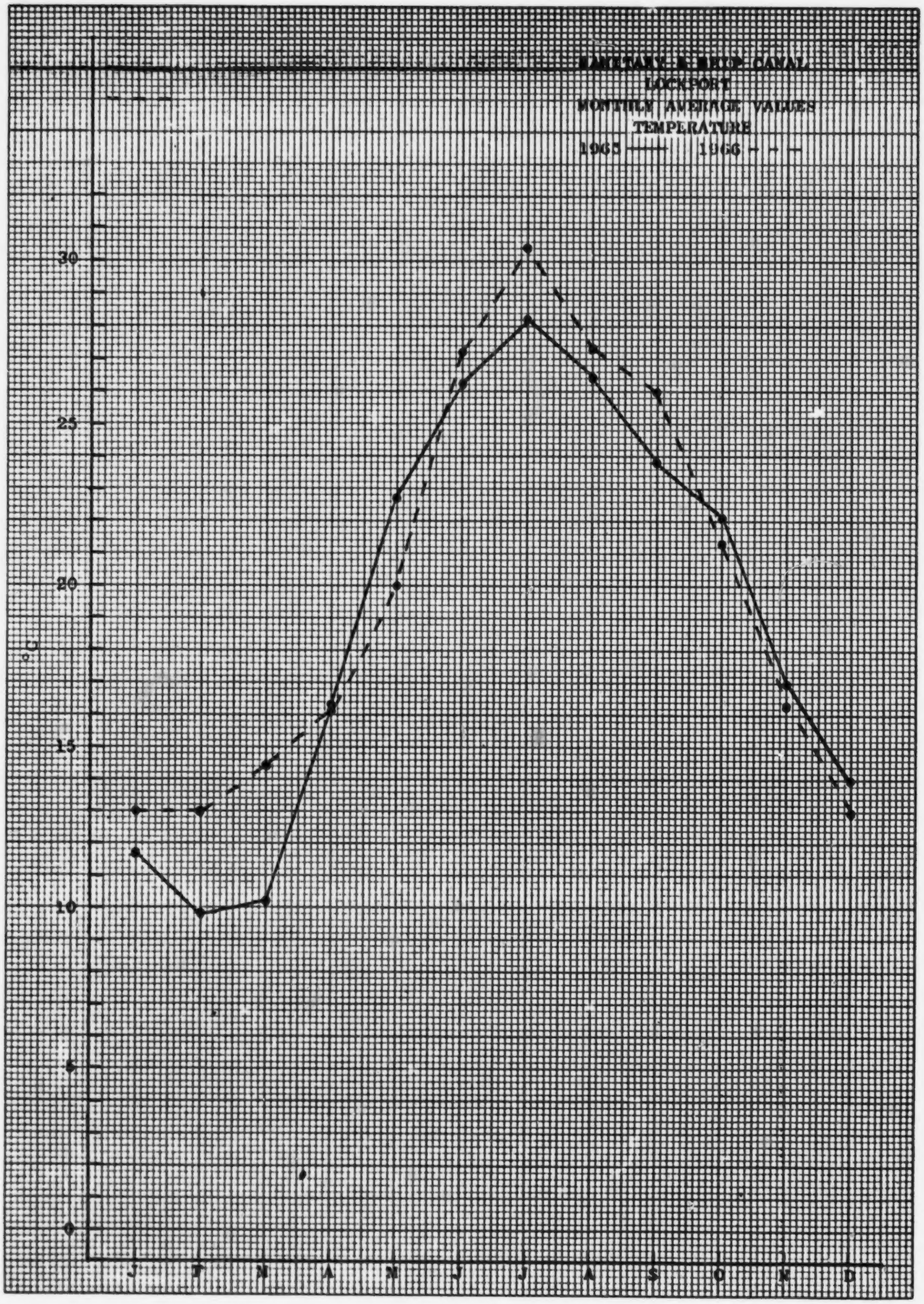

SANITARY & SHIP CANAL
LOCKPORT
MONTHLY AVERAGE VALUES
TEMPERATURE
1965 —— 1966 - - -
°C
0
5
10
15
20
25
30
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 66

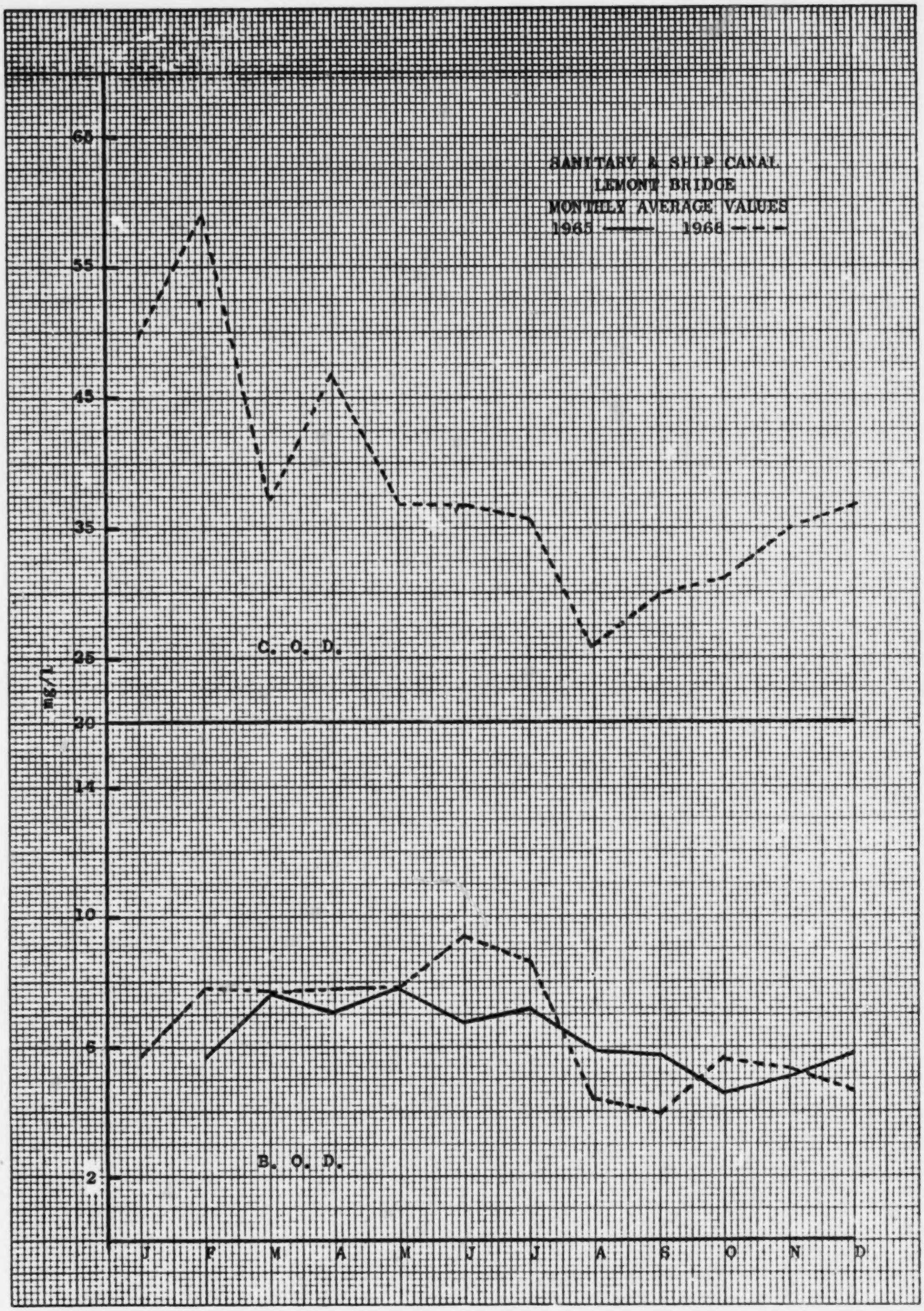

SANITARY & SHIP CANAL
LEMONT BRIDGE
MONTHLY AVERAGE VALUES
1965 ——— 1966 - - -
C. O. D.
B. O. D.
mg/l
65
55
45
35
25
20
14
10
6
2
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 67

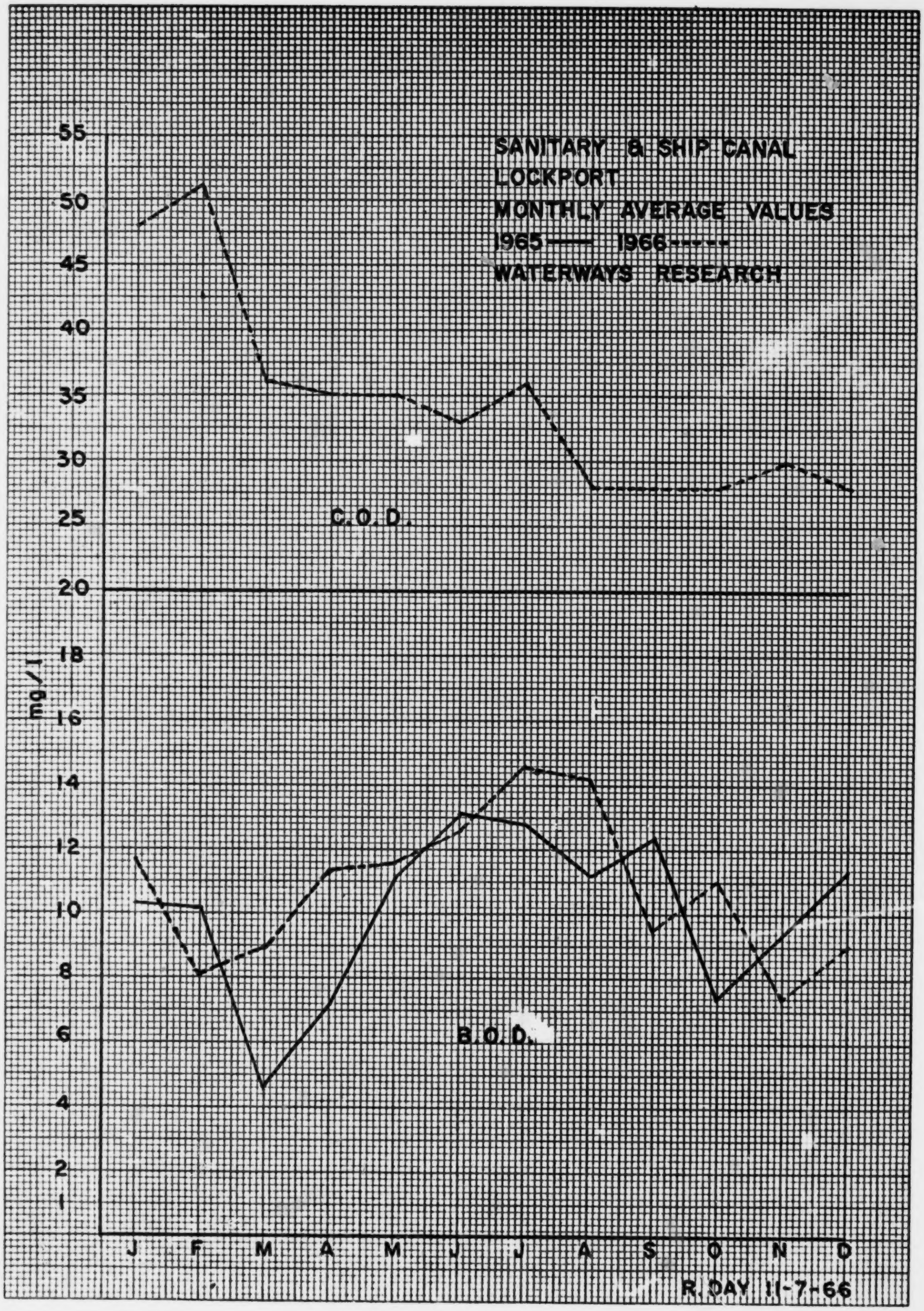

SANITARY & SHIP CANAL
LOCKPORT
MONTHLY AVERAGE VALUES
1965 —— 1966 -----
WATERWAYS RESEARCH
C.O.D.
B.O.D.
mg/l
55
50
45
40
35
30
25
20
18
16
14
12
10
8
6
4
2
1
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-7-66

Fig. 68

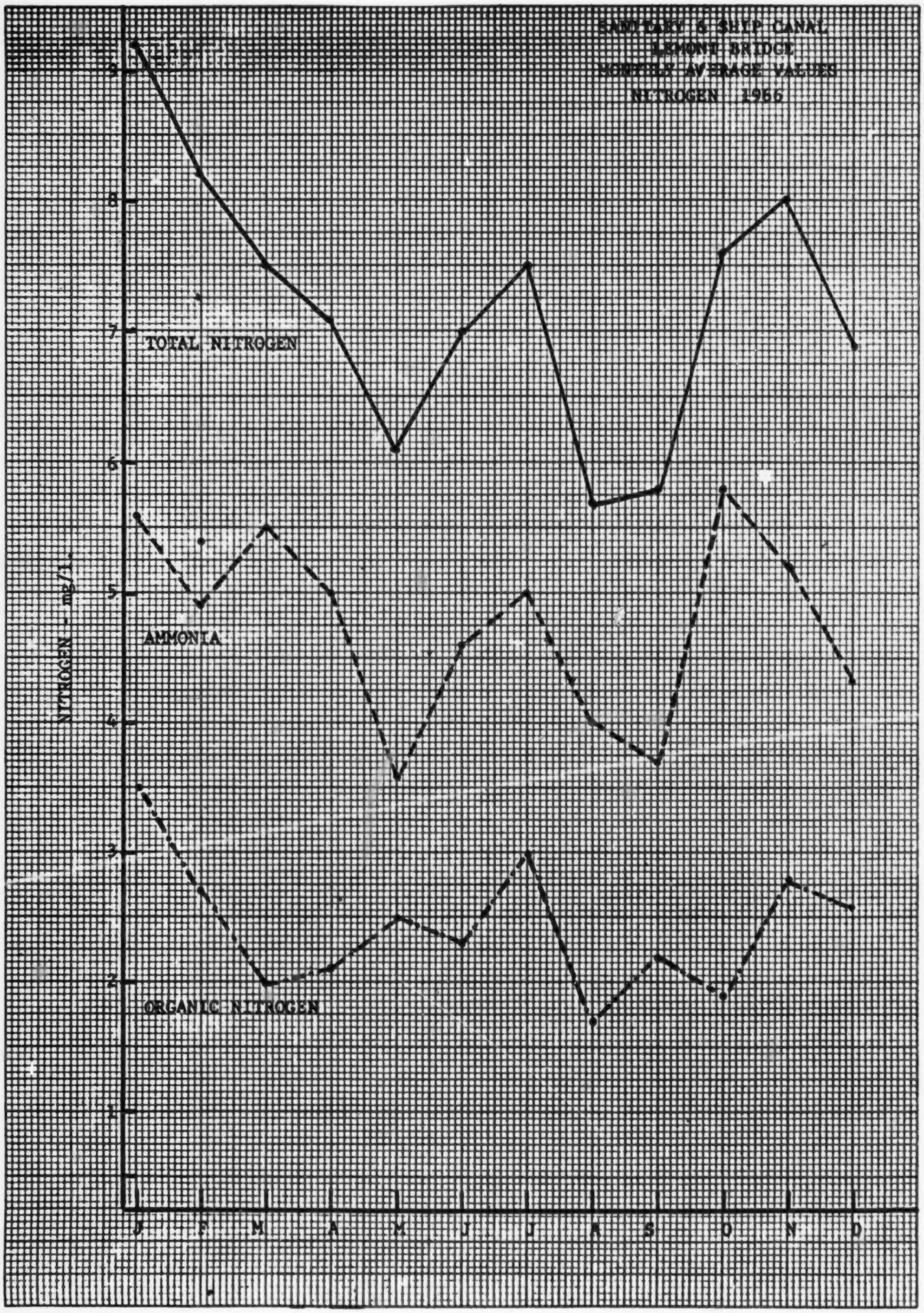

SANITARY & SHIP CANAL
LEMONT BRIDGE
MONTHLY AVERAGE VALUES
NITROGEN 1966
NITROGEN - mg/l
9
8
7
6
5
4
3
2
1
TOTAL NITROGEN
AMMONIA
ORGANIC NITROGEN
J
F
M
A
M
J
J
A
S
O
N
D

Figure 69

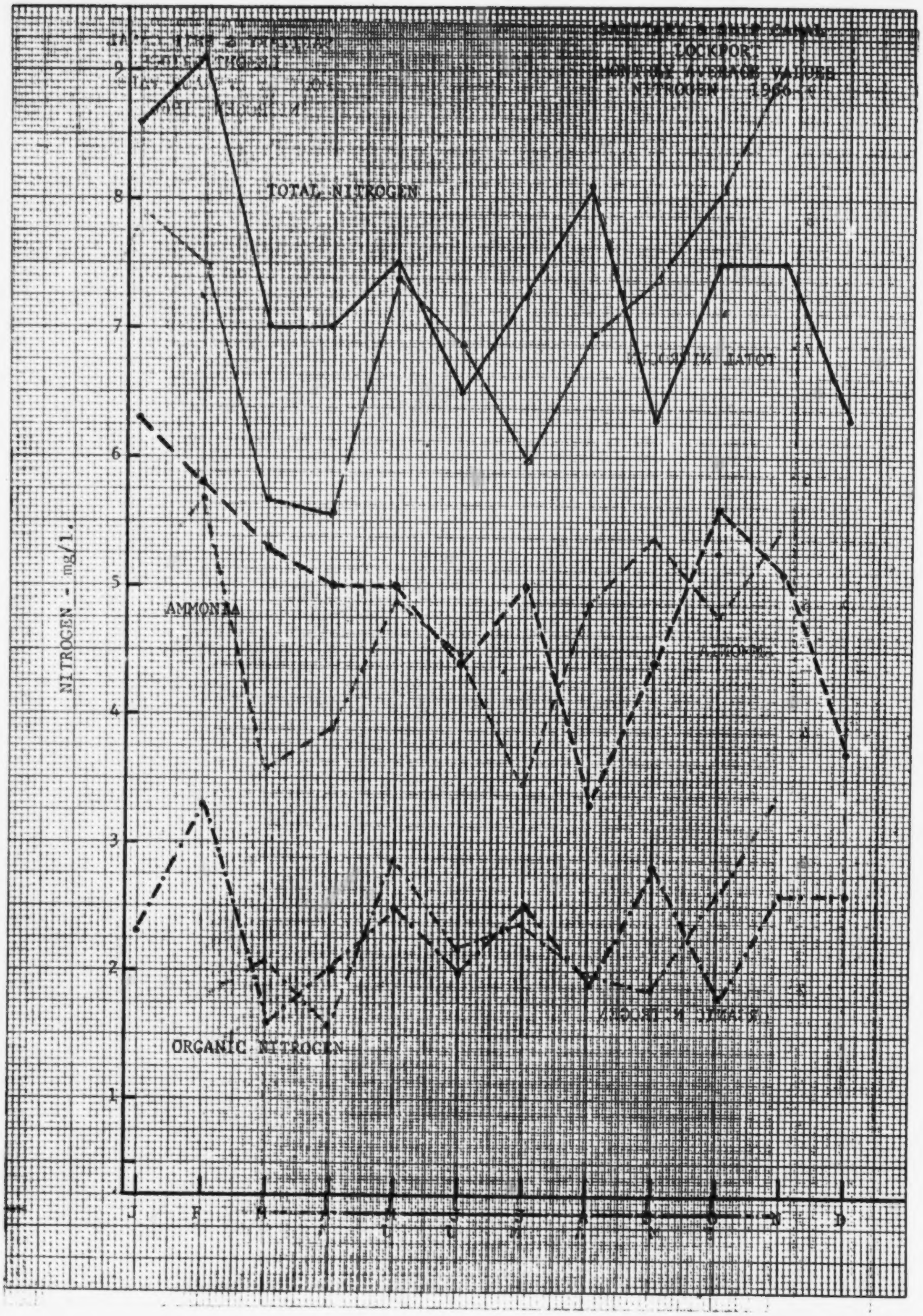

SANITARY & SHIP CANAL
LOCKPORT
MONTHLY AVERAGE VALUES
NITROGEN - 1966
TOTAL NITROGEN
AMMONIA
ORGANIC NITROGEN
NITROGEN - mg/l.
9
8
7
6
5
4
3
2
1
J
F
M
A
M
J
J
A
S
O
N
D

Figure 70

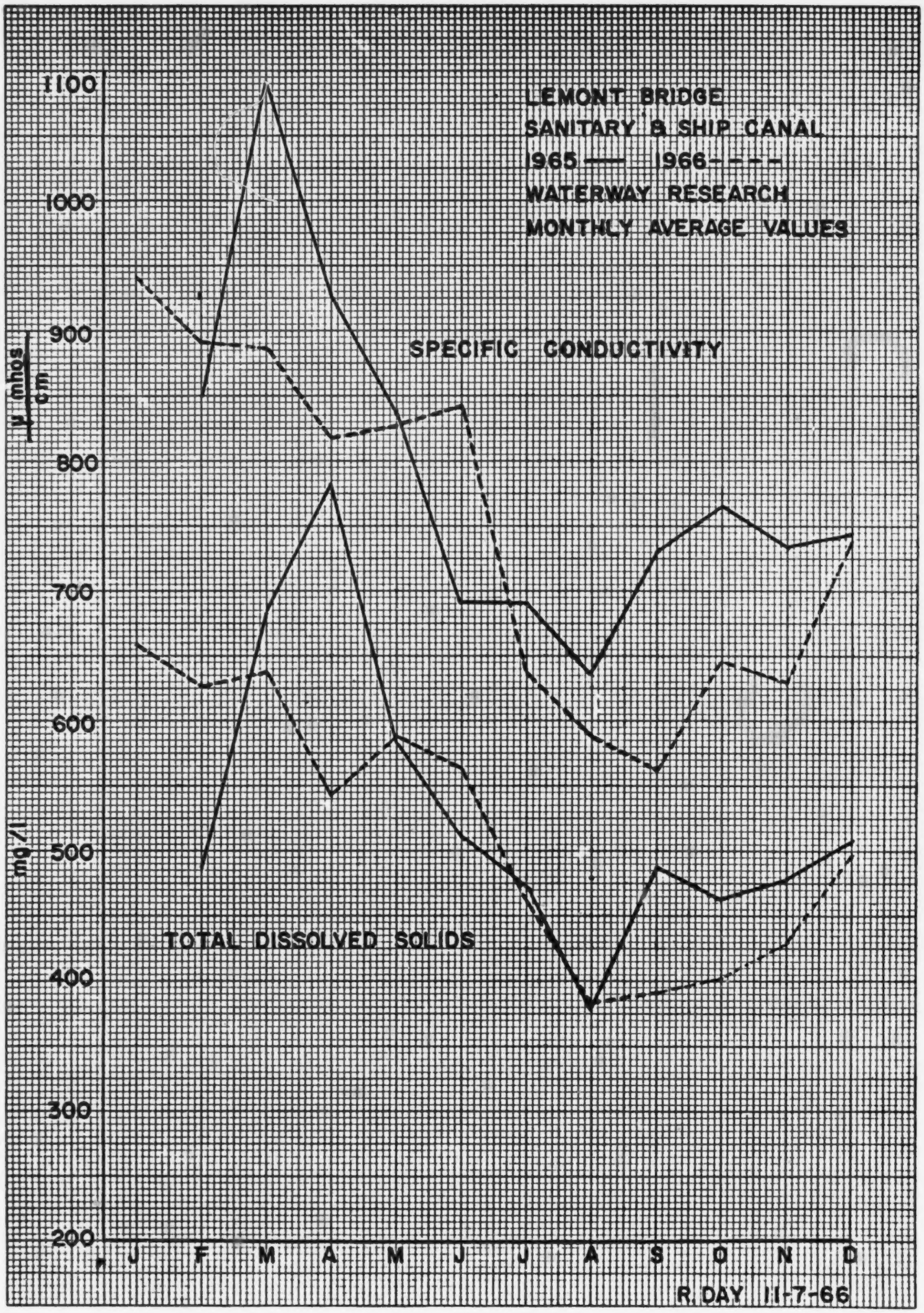

LEMONT BRIDGE
SANITARY & SHIP CANAL
1965 —— 1966 - - - -
WATERWAY RESEARCH
MONTHLY AVERAGE VALUES
SPECIFIC CONDUCTIVITY
TOTAL DISSOLVED SOLIDS
μ mhos / cm
mg/l
1100
1000
900
800
700
600
500
400
300
200
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-7-66

Figure 71

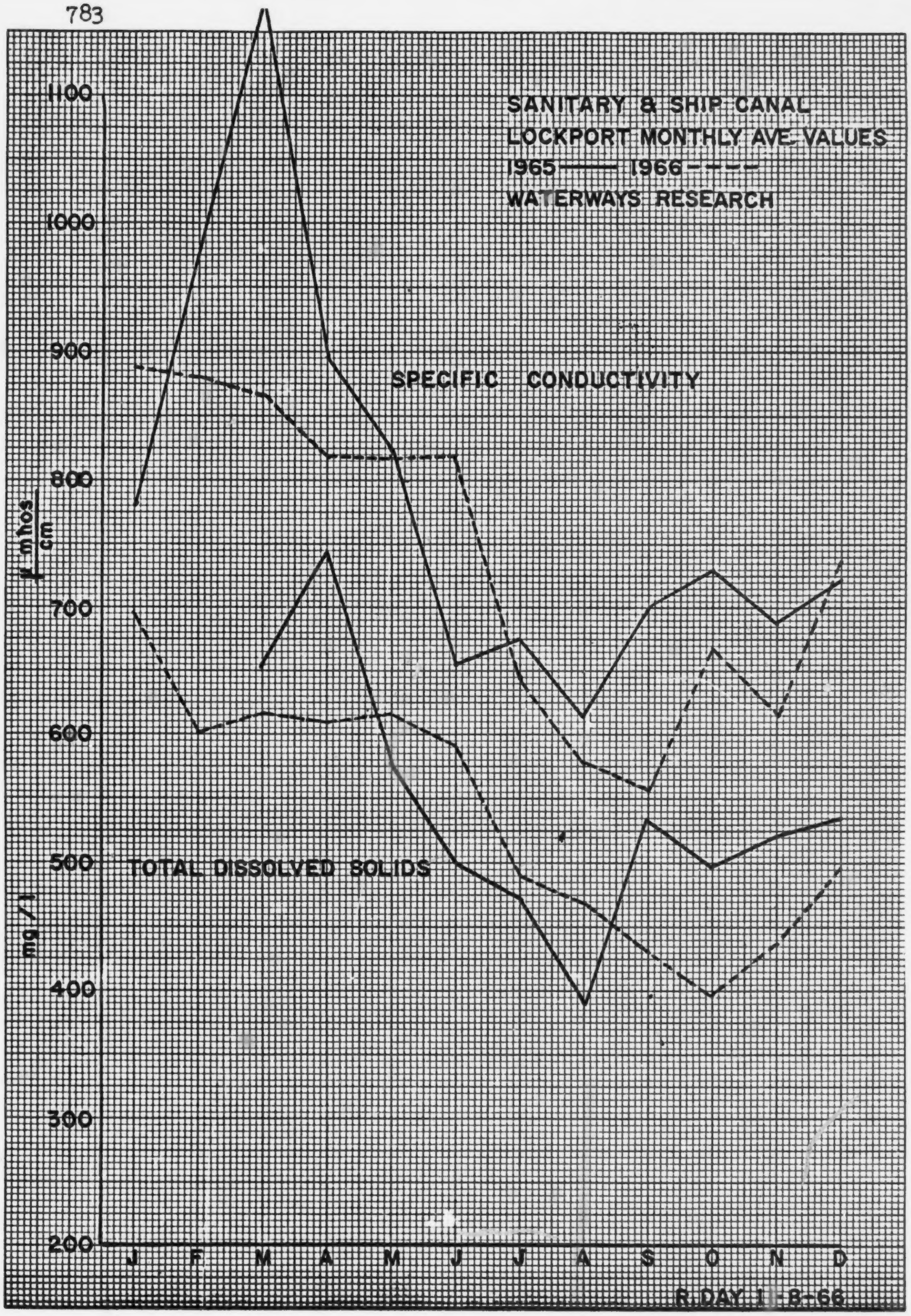

SANITARY & SHIP CANAL
LOCKPORT MONTHLY AVE. VALUES
1965 —— 1966 - - - -
WATERWAYS RESEARCH
SPECIFIC CONDUCTIVITY
TOTAL DISSOLVED SOLIDS
µ mhos / cm
mg / l
1100
1000
900
800
700
600
500
400
300
200
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 1 8-66

Figure 72

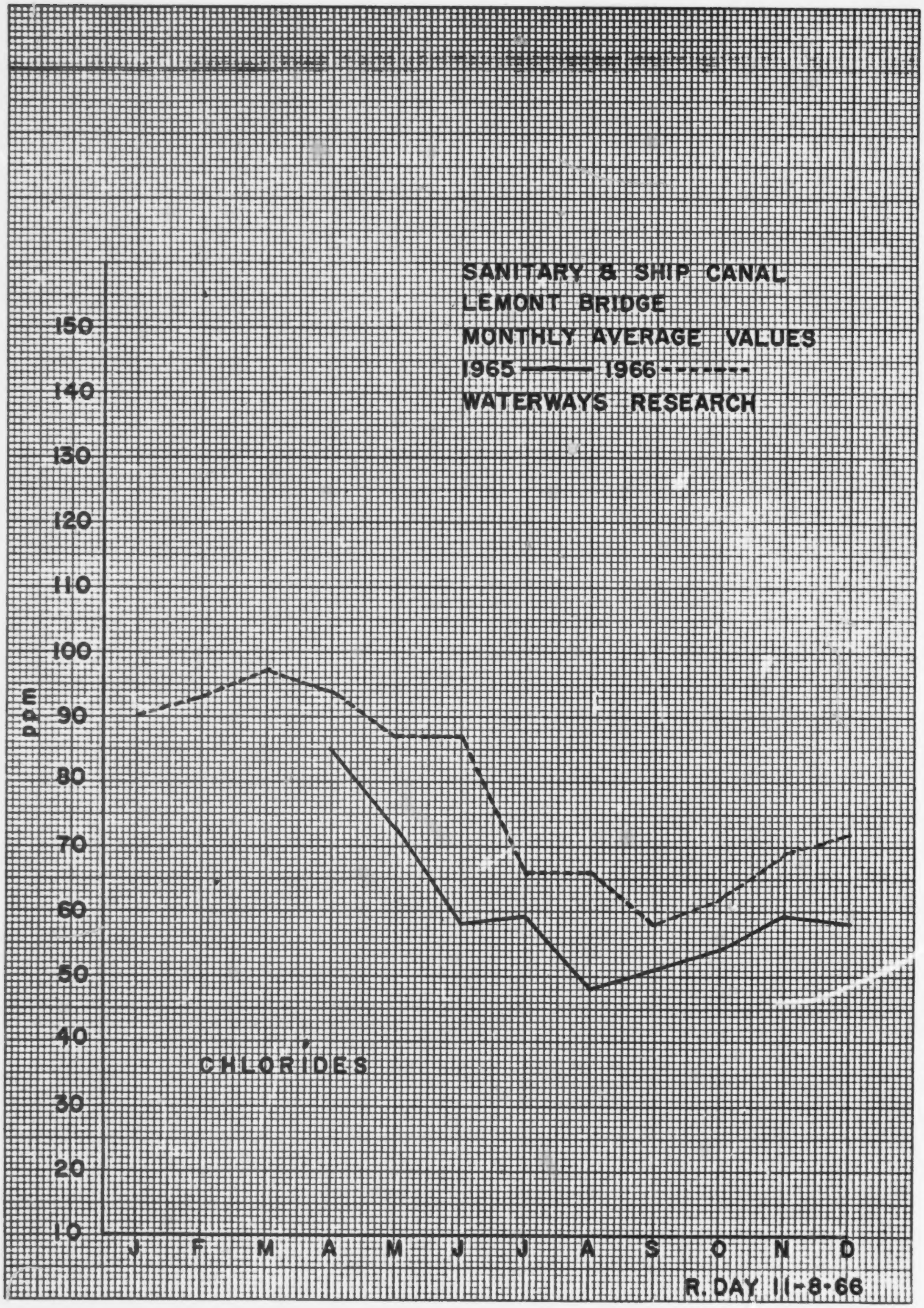

SANITARY & SHIP CANAL
LEMONT BRIDGE
MONTHLY AVERAGE VALUES
1965 ——— 1966 - - - - - - -
WATERWAYS RESEARCH
ppm
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
CHLORIDES
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-8-66

Figure 73

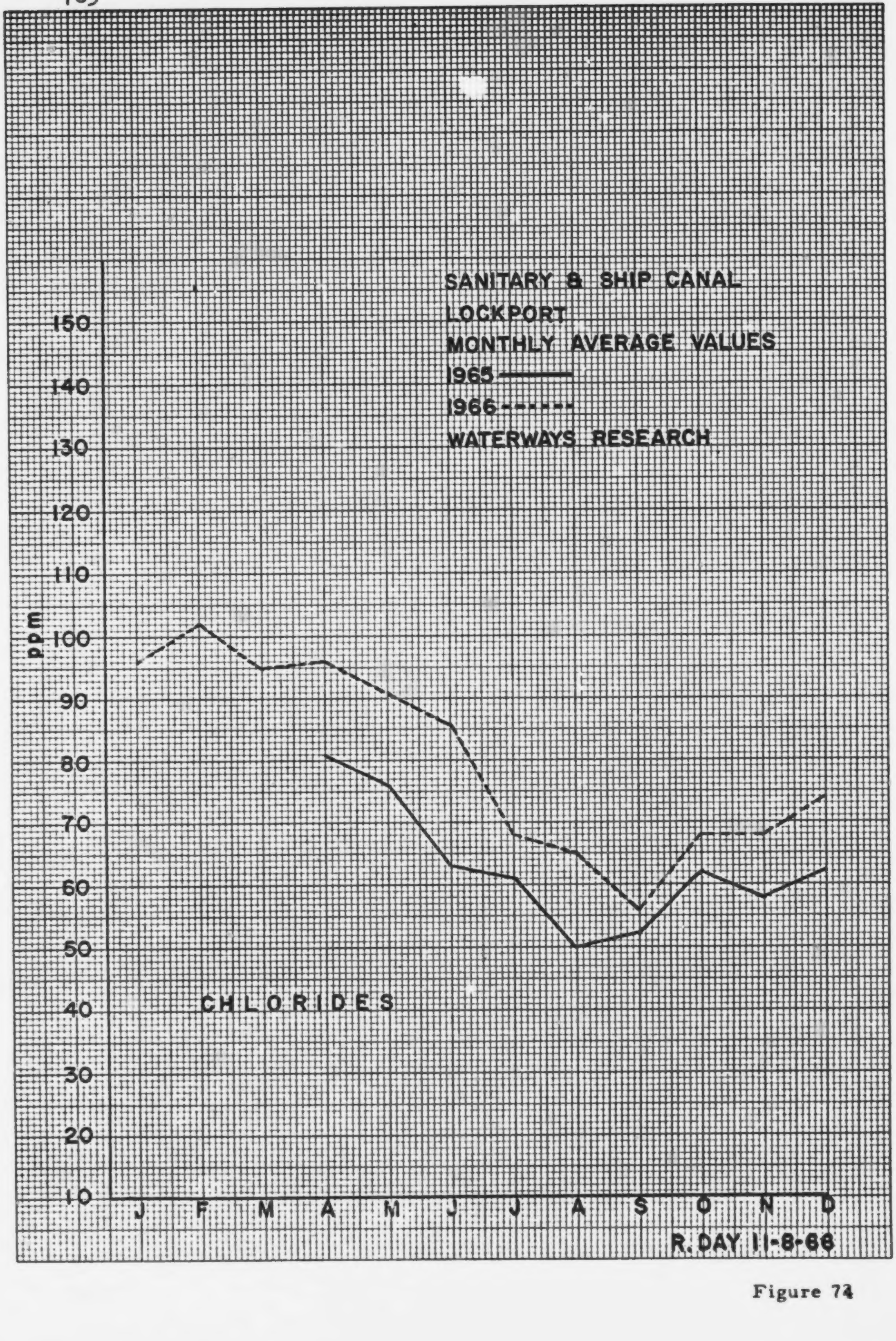
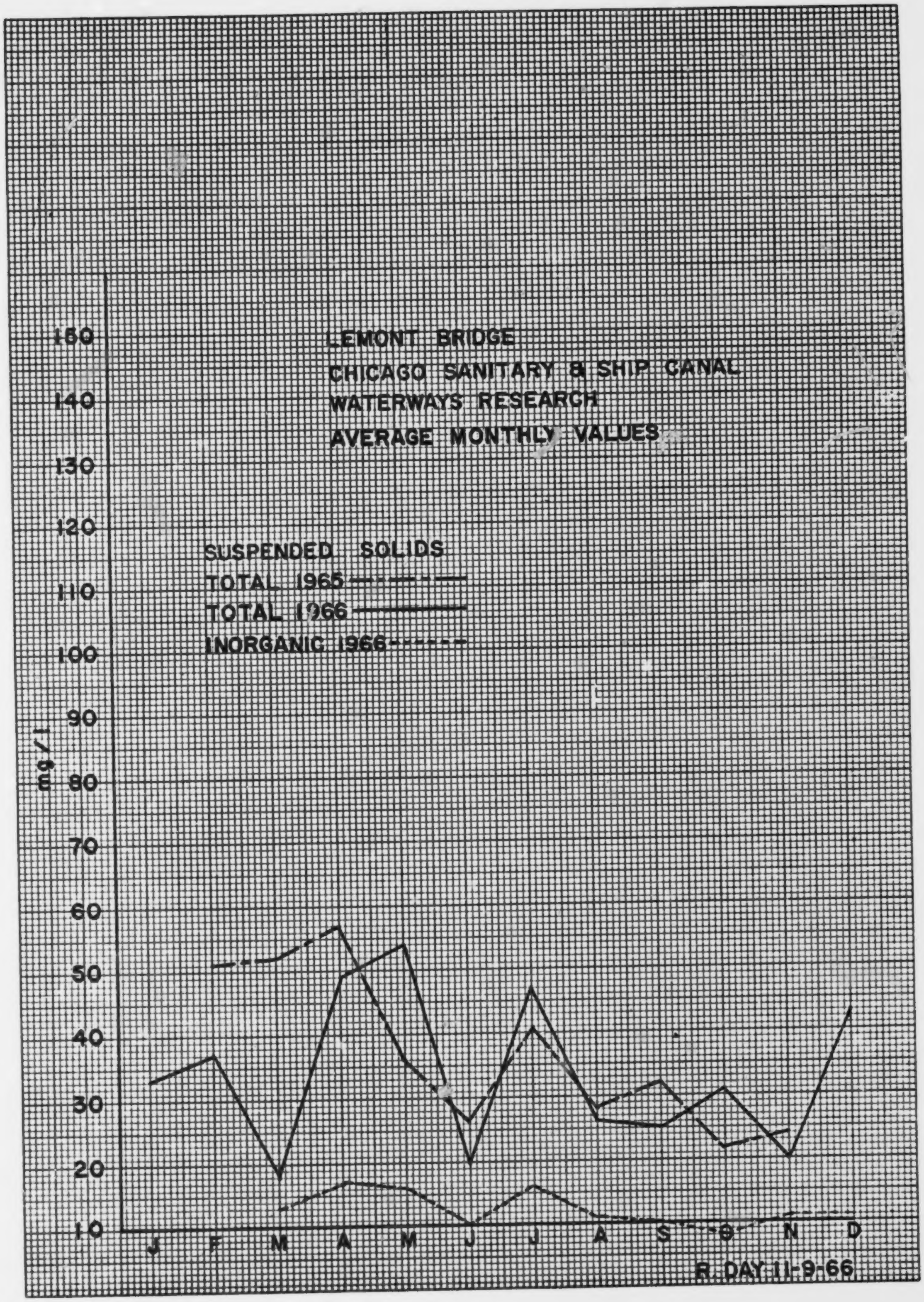

SANITARY & SHIP CANAL
LOCKPORT
MONTHLY AVERAGE VALUES
1965 ———
1966 - - - - - -
WATERWAYS RESEARCH
ppm
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
CHLORIDES
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-8-66

Figure 74


LEMONT BRIDGE
CHICAGO SANITARY & SHIP CANAL
WATERWAYS RESEARCH
AVERAGE MONTHLY VALUES
SUSPENDED SOLIDS
TOTAL 1965
TOTAL 1966
INORGANIC 1966
mg/l
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-9-66

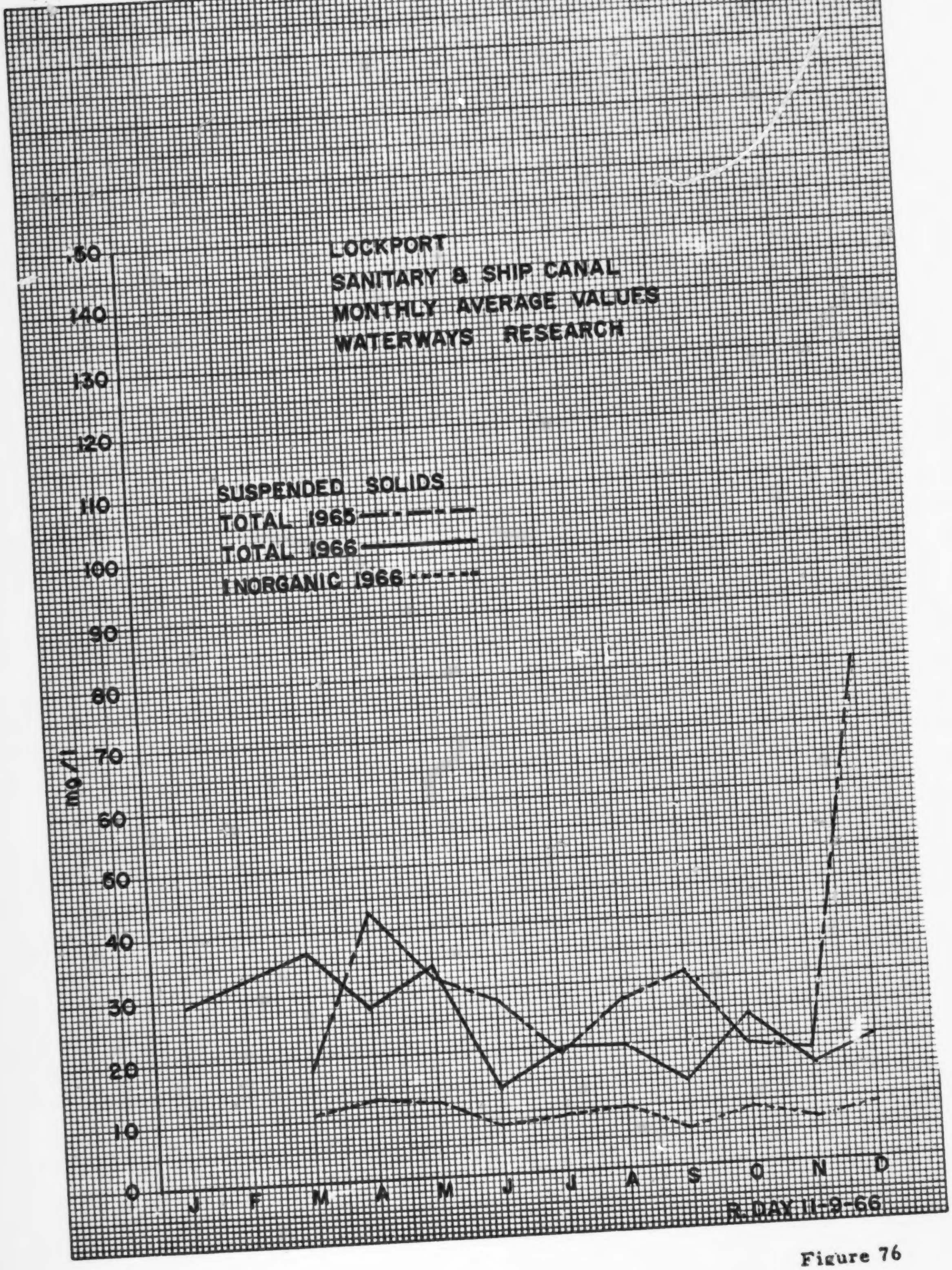

LOCKPORT
SANITARY & SHIP CANAL
MONTHLY AVERAGE VALUES
WATERWAYS RESEARCH
SUSPENDED SOLIDS
TOTAL 1965
TOTAL 1966
INORGANIC 1966
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
mg/l
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-9-66

Figure 76

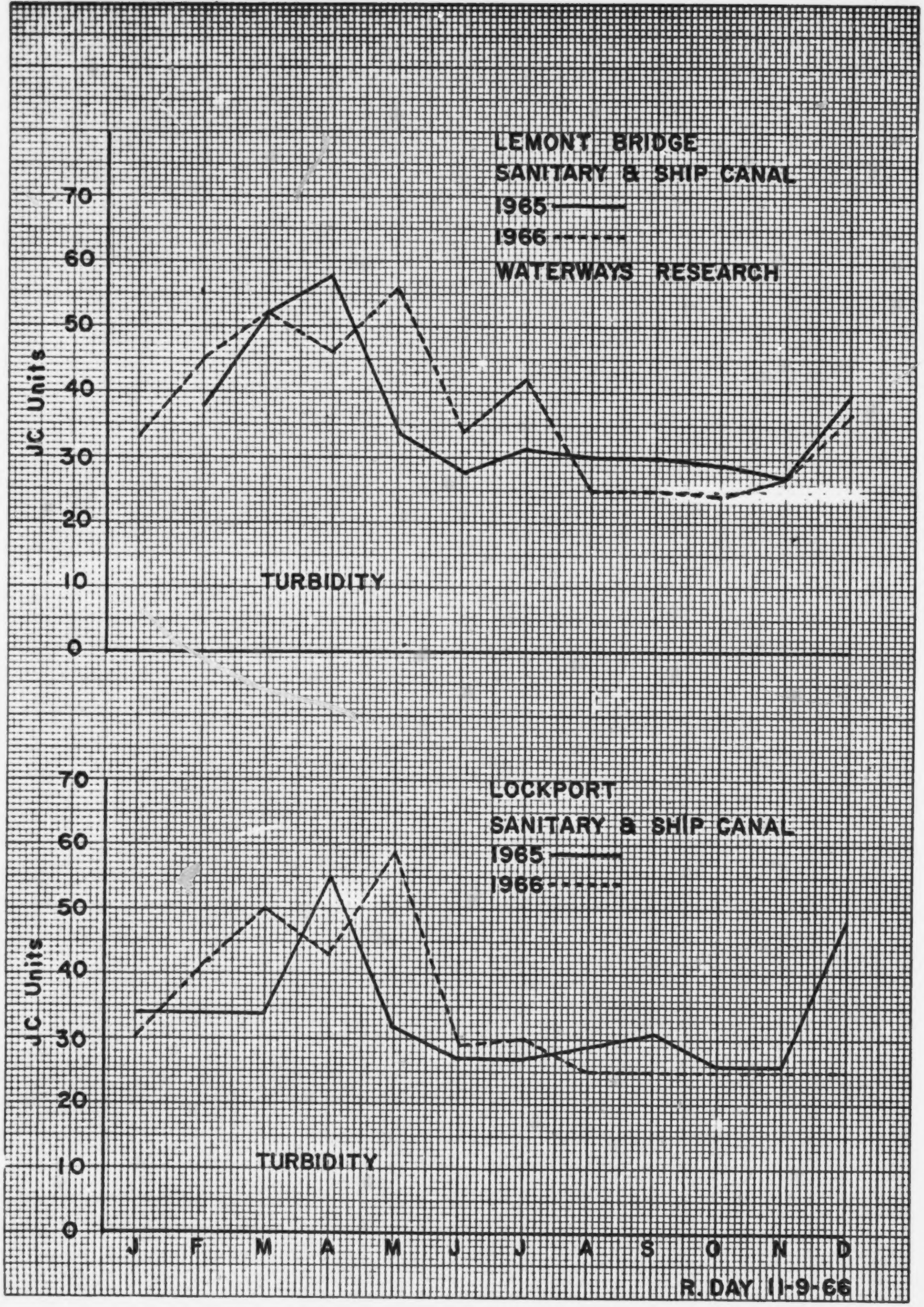

LEMONT BRIDGE
SANITARY & SHIP CANAL
1965
1966
WATERWAYS RESEARCH
JC Units
70
60
50
40
30
20
10
0
TURBIDITY
LOCKPORT
SANITARY & SHIP CANAL
1965
1966
JC Units
70
60
50
40
30
20
10
0
TURBIDITY
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-9-66

Figure 77

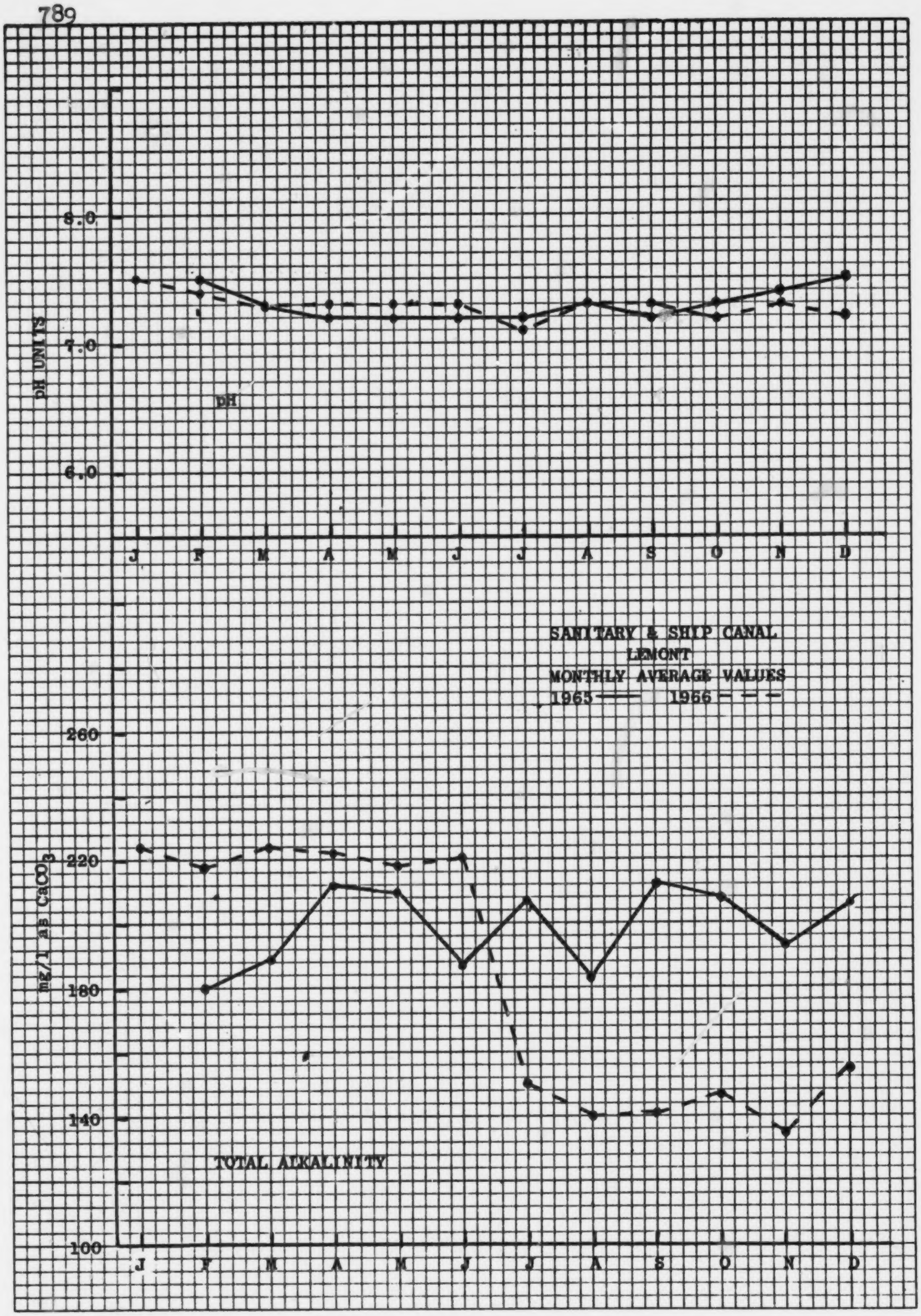

pH UNITS
8.0
7.0
6.0
pH
J
F
M
A
M
J
J
A
S
O
N
D
SANITARY & SHIP CANAL
LEMONT
MONTHLY AVERAGE VALUES
1965 ——— 1966 — — —
mg/1 as CaCO3
260
220
180
140
100
TOTAL ALKALINITY
J
F
M
A
M
J
J
A
S
O
N
D

Figure 78

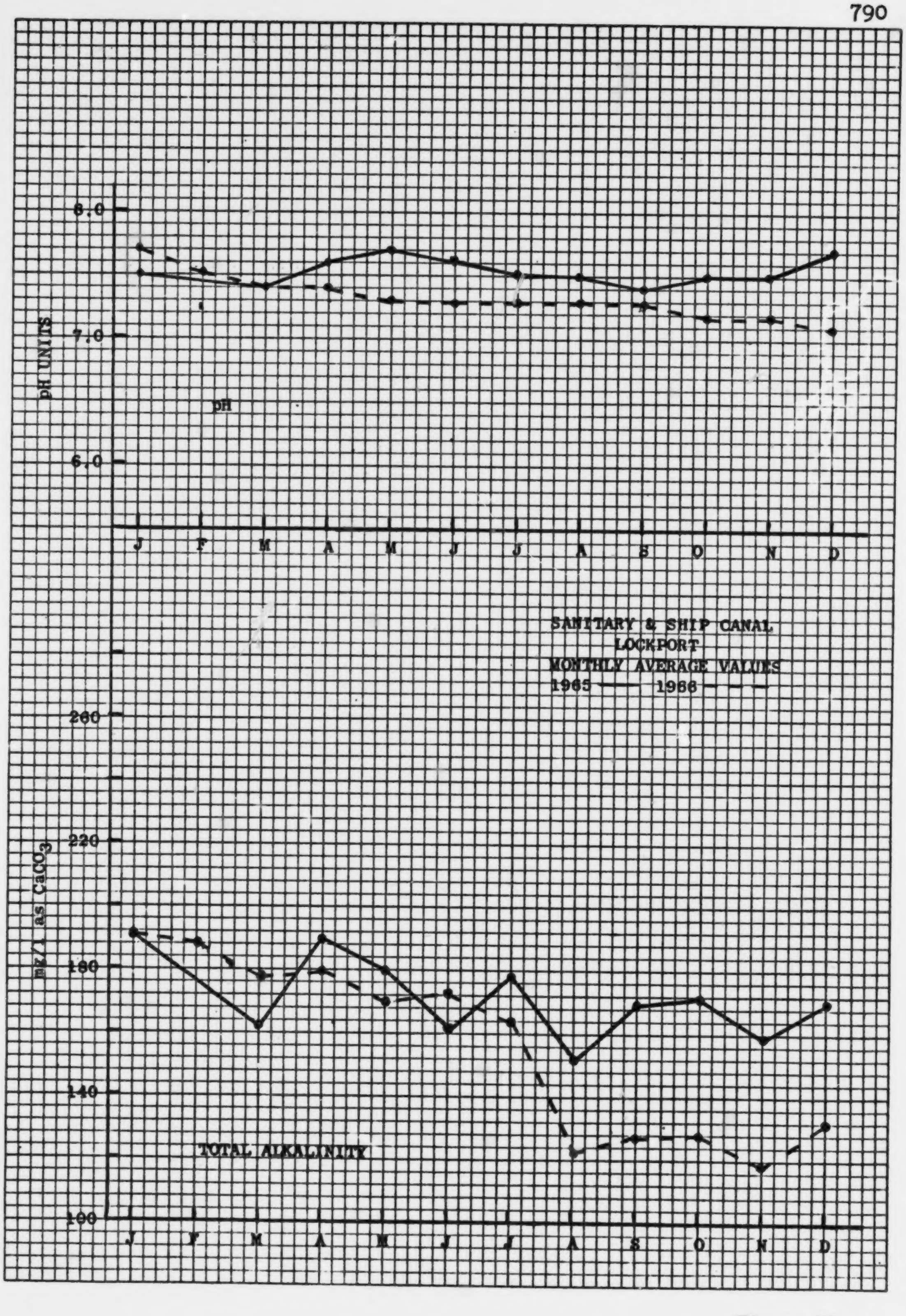
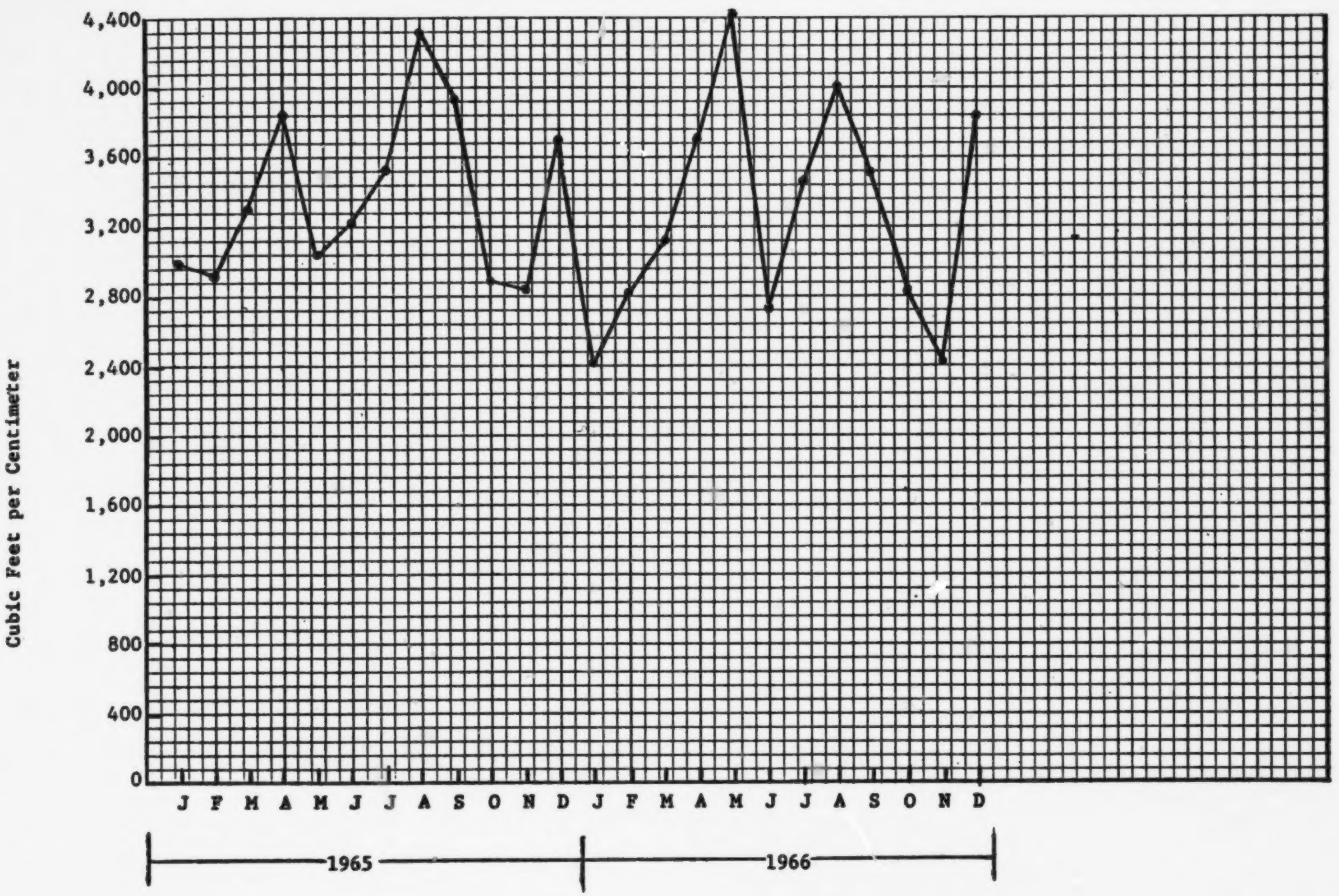
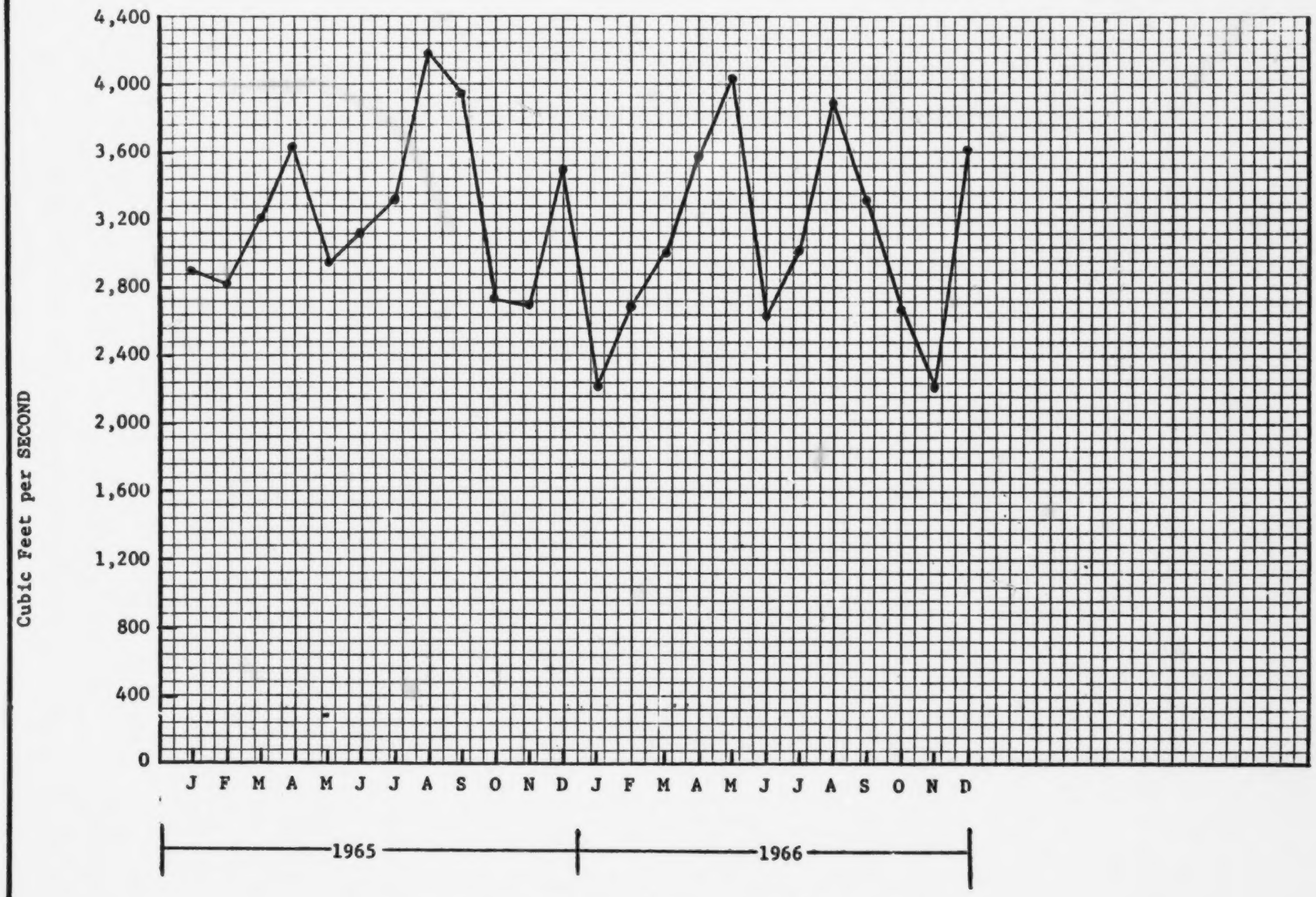

pH UNITS
8.0
7.0
6.0
pH
J F M A M J J A S O N D
SANITARY & SHIP CANAL
LOCKPORT
MONTHLY AVERAGE VALUES
1965 —— 1966 - - -
mg/l as CaCO$_3$
260
220
180
140
100
TOTAL ALKALINITY
J F M A M J J A S O N D

Figure 79



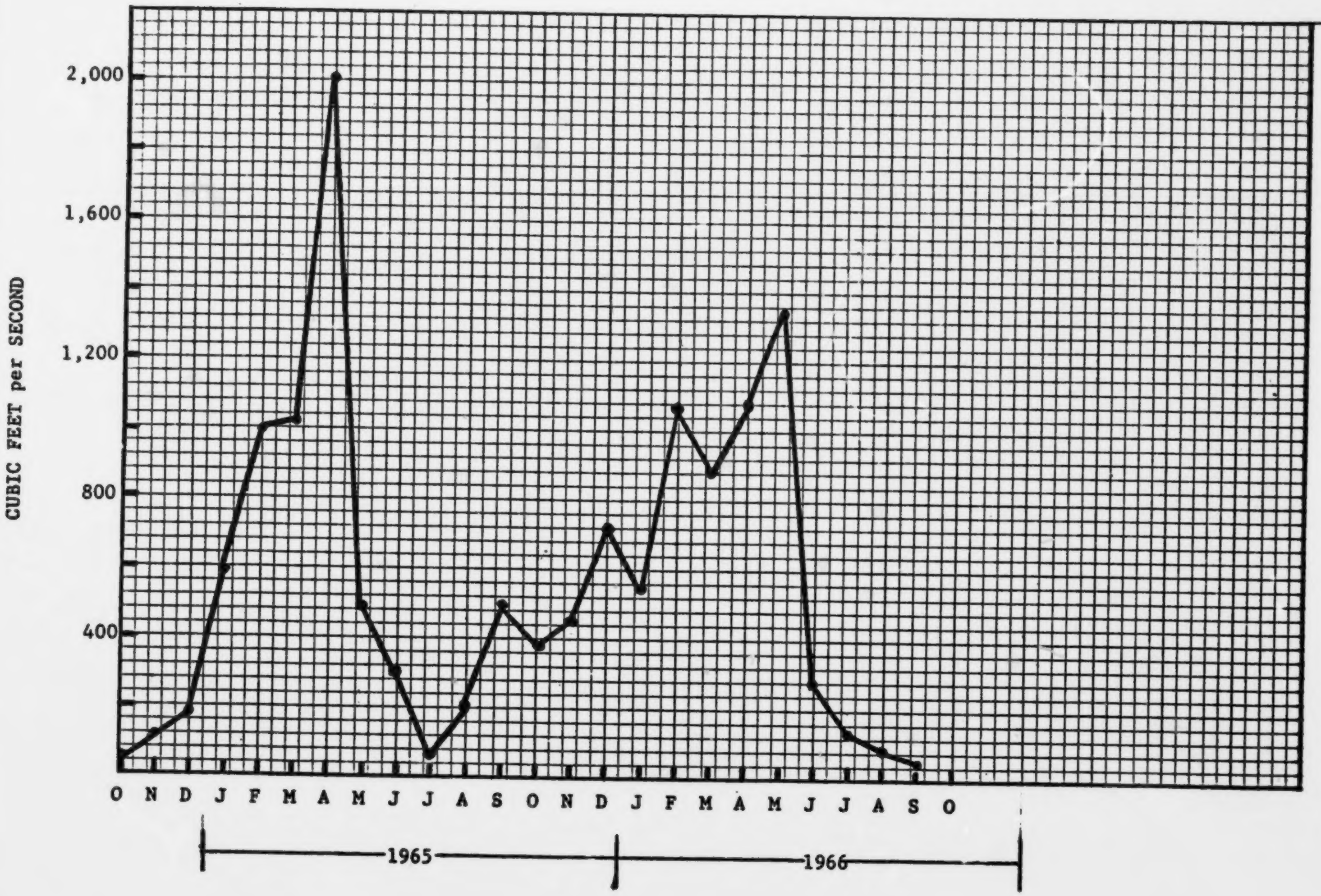
Monthly Mean Discharge Sanitary and Ship Canal at Lemont

Figure 80



Monthly Mean Discharge Sanitary and Ship Canal at Lockport

Figure 81



MONTHLY MEAN DISCHARGE DES PLAINES RIVER AT LEMONT RD

Figure 82

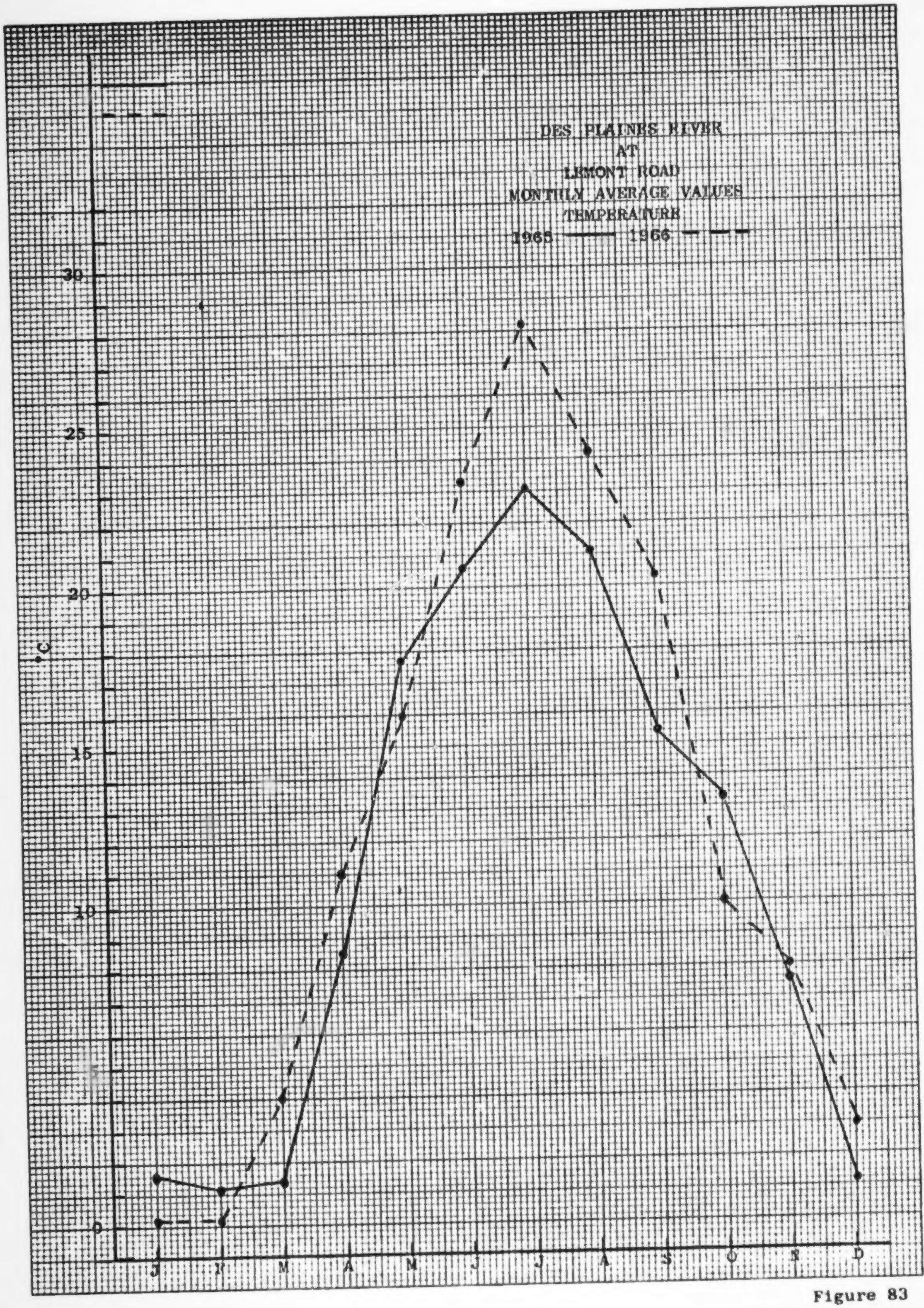

DES PLAINES RIVER
AT
LEMONT ROAD
MONTHLY AVERAGE VALUES
TEMPERATURE
1965 ——— 1966 — — —
°C
30
25
20
15
10
5
0
J
F
M
A
M
J
J
A
S
O
N
D

Figure 83

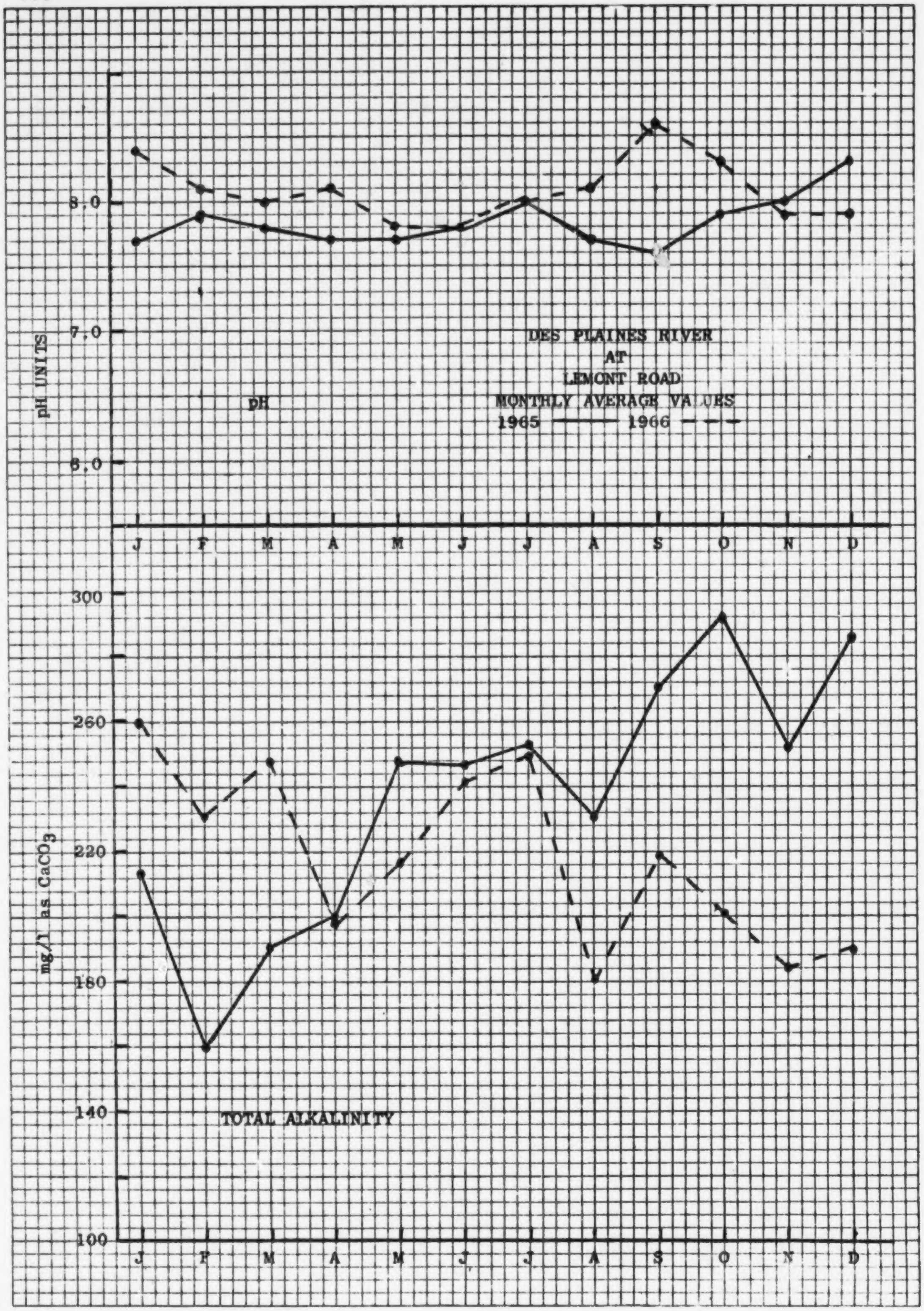

DES PLAINES RIVER
AT
LEMONT ROAD
MONTHLY AVERAGE VALUES
1965 —— 1966 - - -
pH UNITS
8.0
7.0
6.0
pH
J
F
M
A
M
J
J
A
S
O
N
D
mg/l as $CaCO_3$
300
260
220
180
140
100
TOTAL ALKALINITY

Figure 84

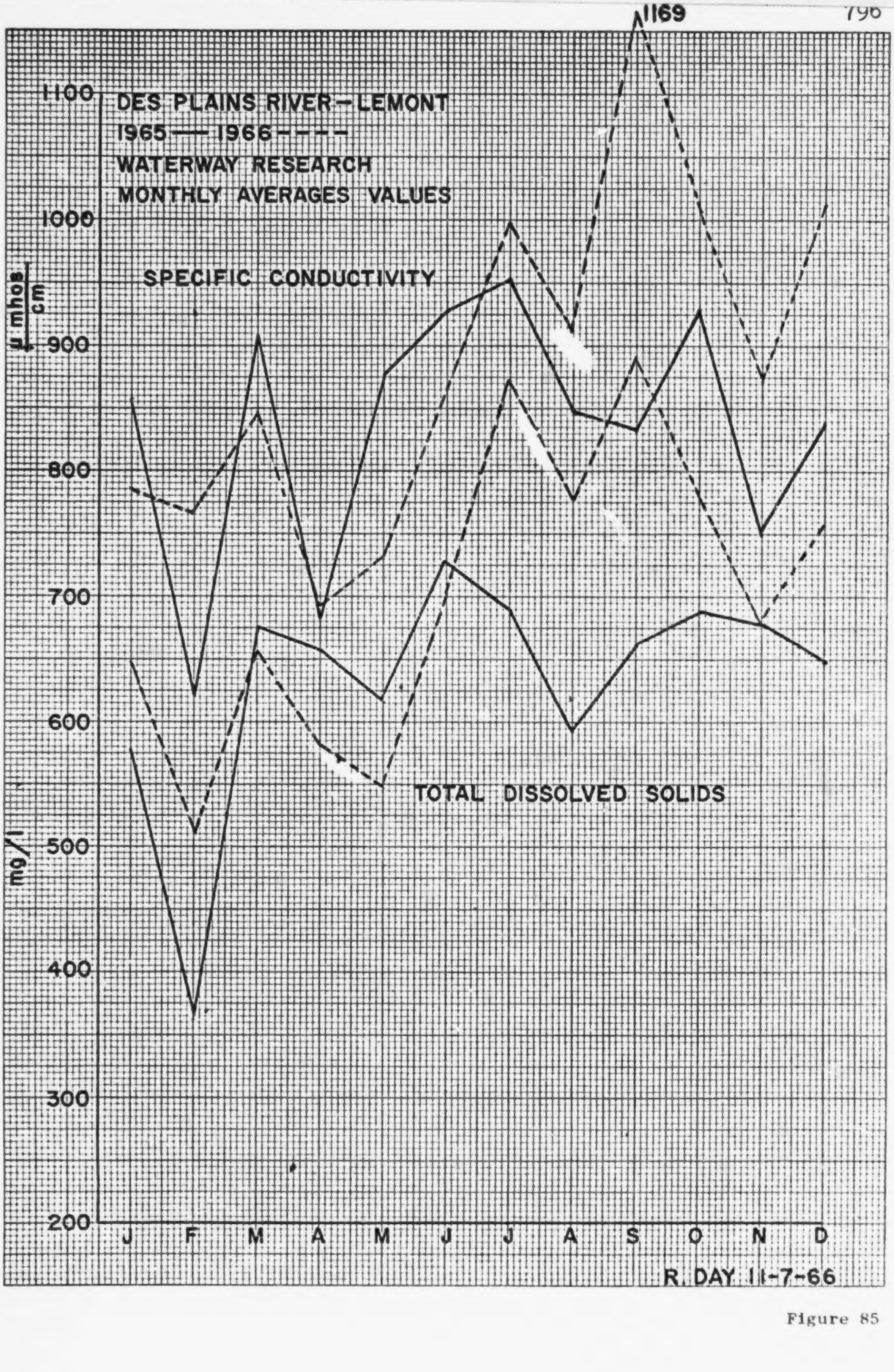

1169
DES PLAINS RIVER — LEMONT
1965 —— 1966 - - - -
WATERWAY RESEARCH
MONTHLY AVERAGES VALUES
SPECIFIC CONDUCTIVITY
TOTAL DISSOLVED SOLIDS
μ mhos / cm
mg/l
1100
1000
900
800
700
600
500
400
300
200
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-7-66

Figure 85

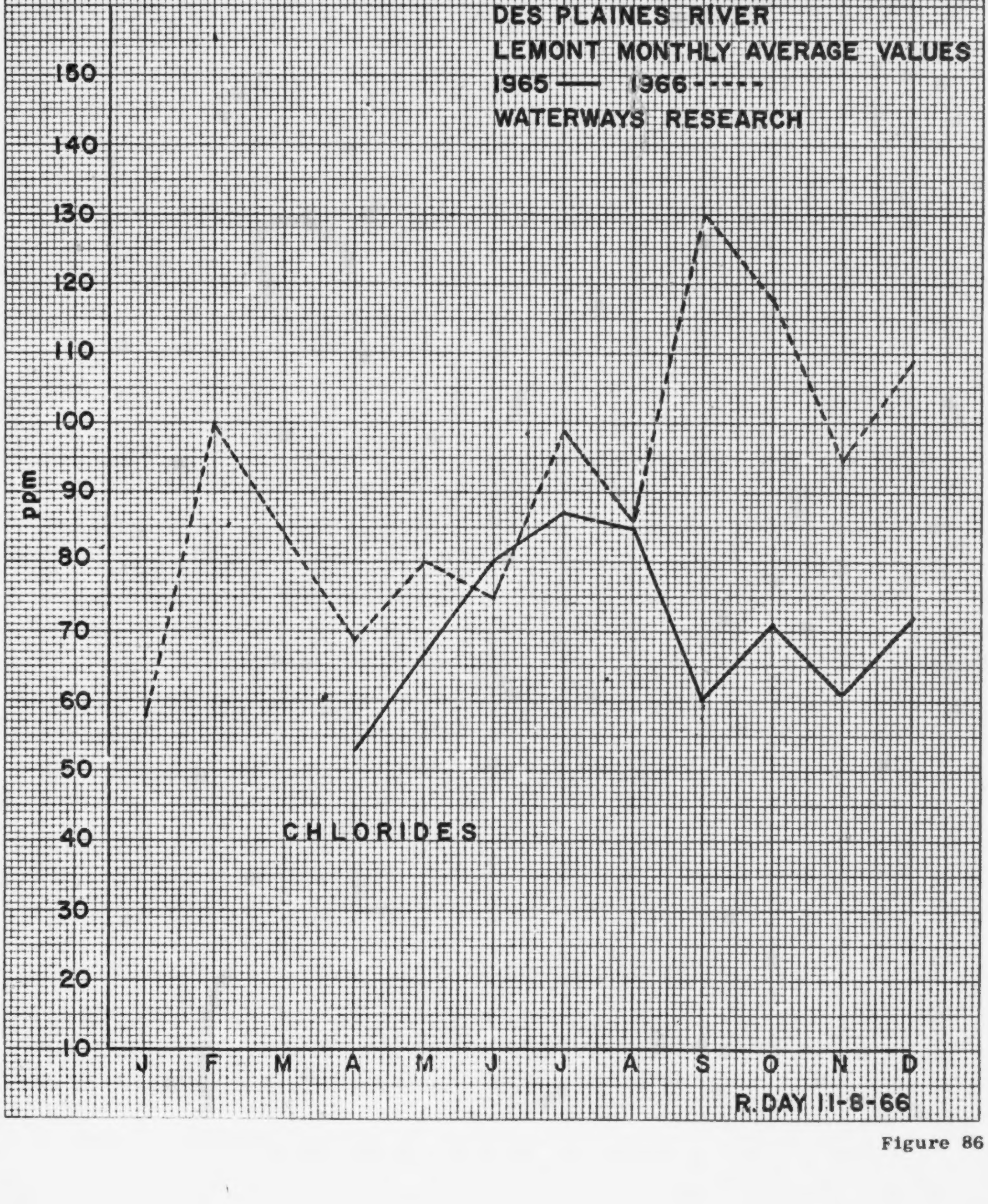

DES PLAINES RIVER
LEMONT MONTHLY AVERAGE VALUES
1965 —— 1966 - - - - -
WATERWAYS RESEARCH
ppm
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
J
F
M
A
M
J
J
A
S
O
N
D
CHLORIDES
R. DAY 11-8-66

Figure 86

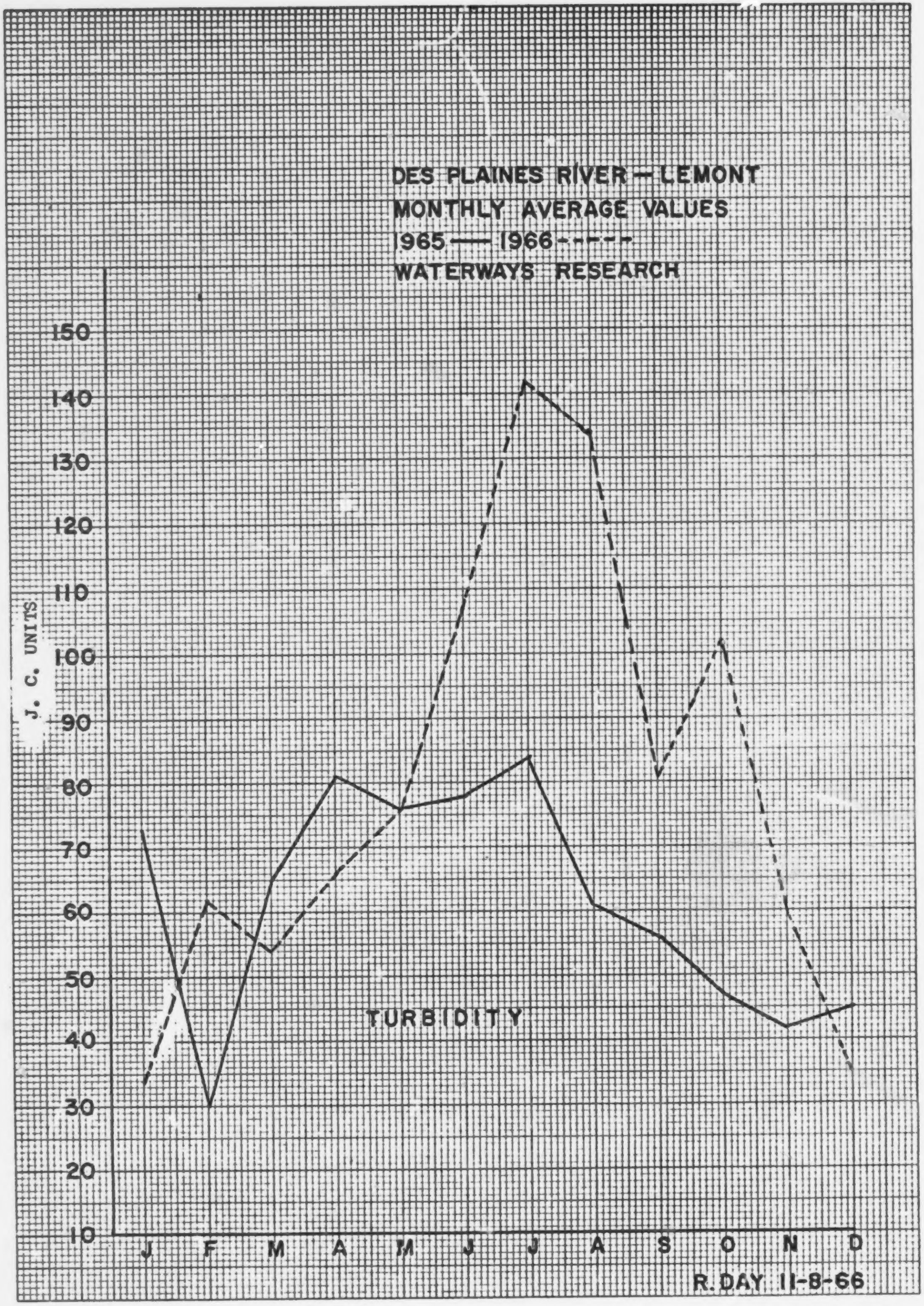

DES PLAINES RIVER — LEMONT
MONTHLY AVERAGE VALUES
1965 —— 1966 - - - -
WATERWAYS RESEARCH
J. C. UNITS
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
TURBIDITY
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-8-66

Figure 87

199

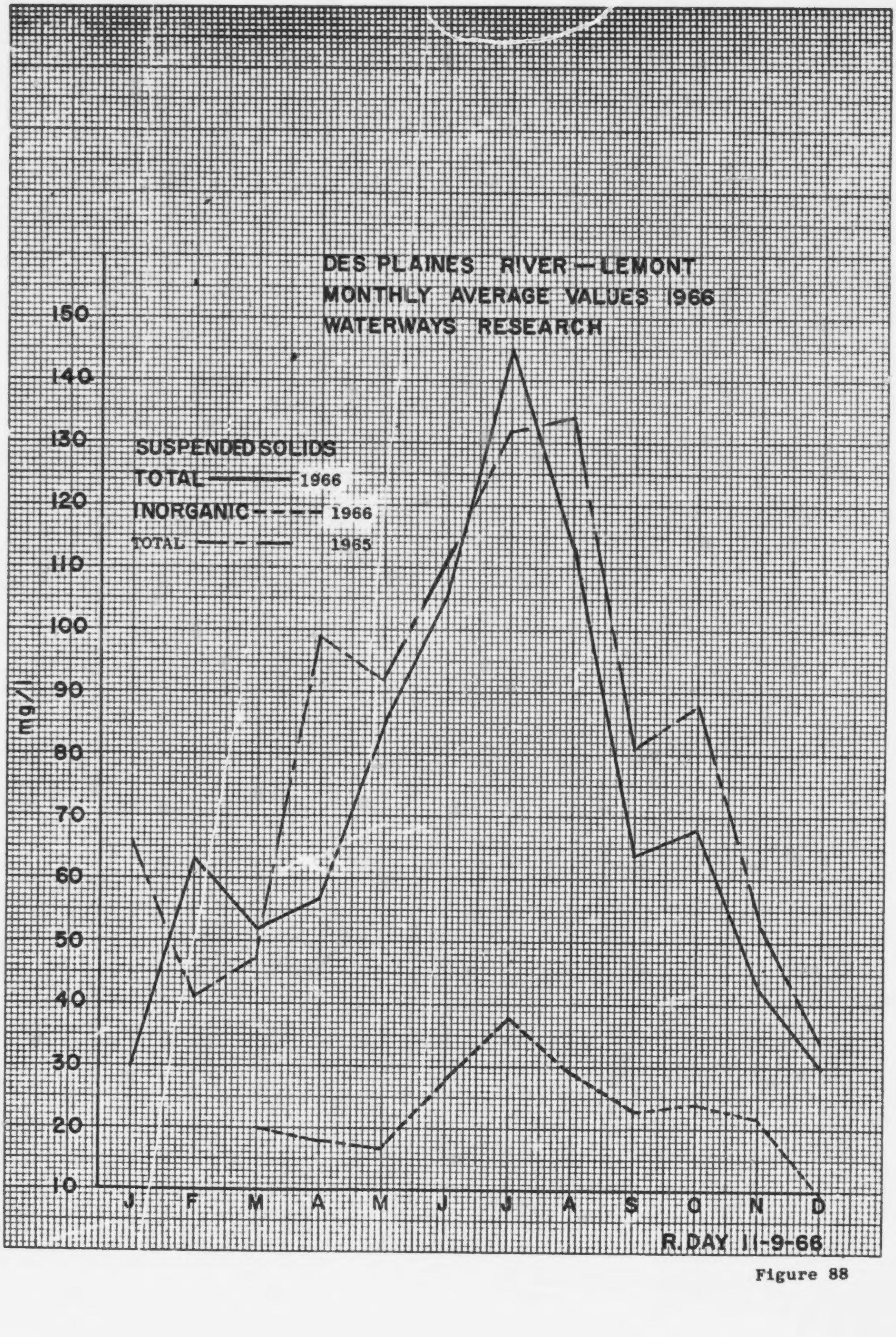


Figure 88

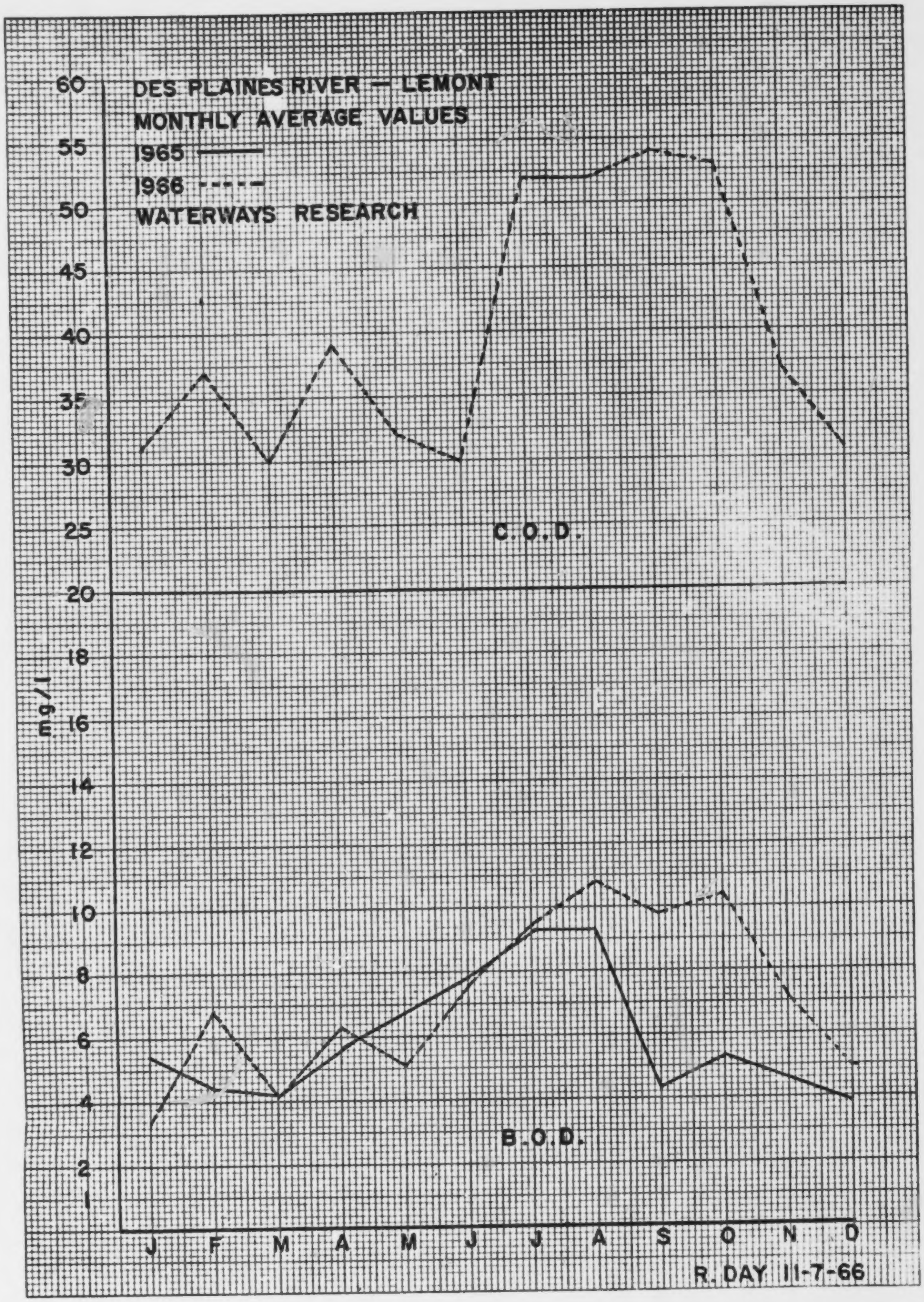

DES PLAINES RIVER — LEMONT
MONTHLY AVERAGE VALUES
1965 ———
1966 - - - -
WATERWAYS RESEARCH
C.O.D.
B.O.D.
mg/l
60
55
50
45
40
35
30
25
20
18
16
14
12
10
8
6
4
2
1
J
F
M
A
M
J
J
A
S
O
N
D
R. DAY 11-7-66

Figure 89

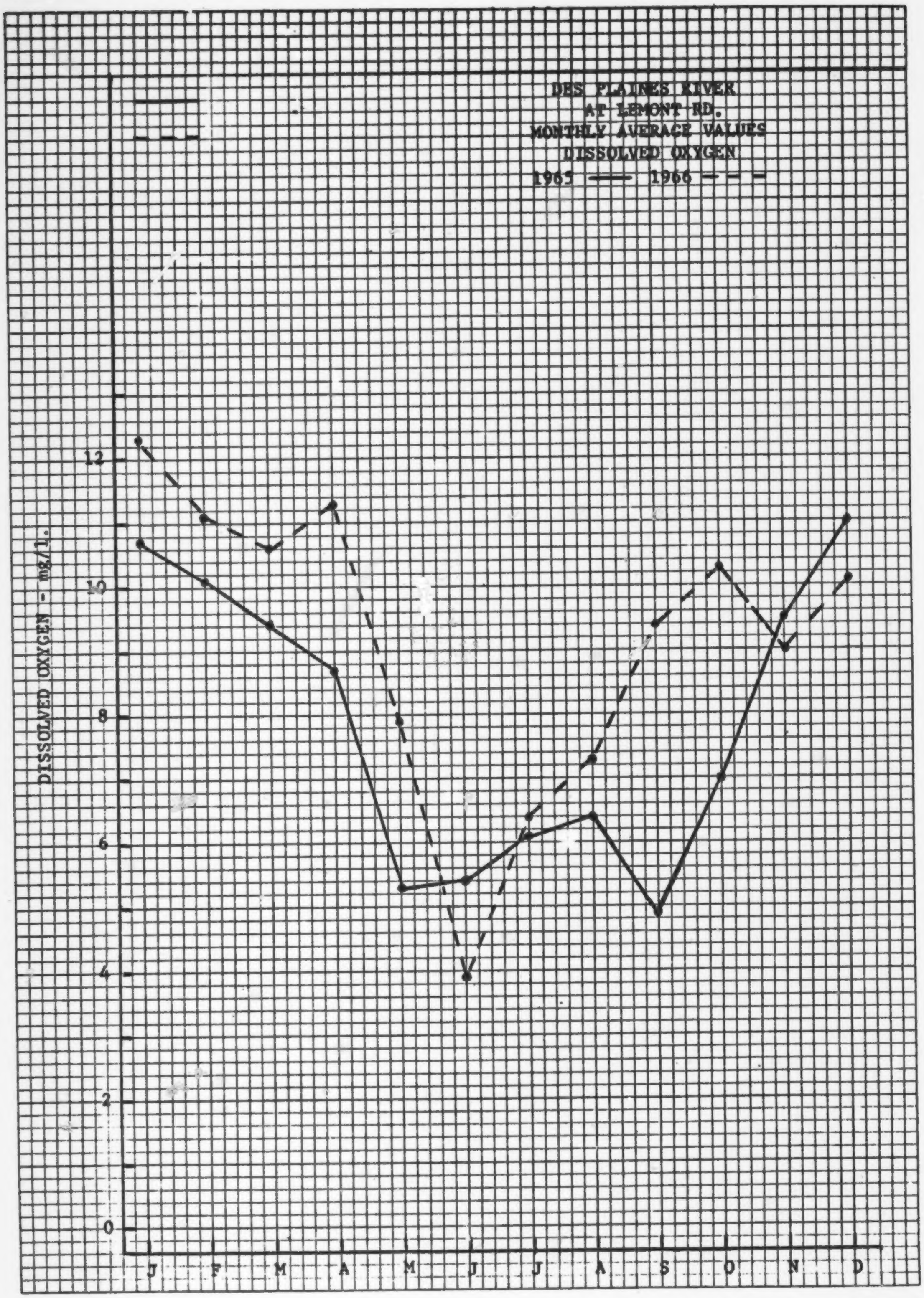

DES PLAINES RIVER
AT LEMONT RD.
MONTHLY AVERAGE VALUES
DISSOLVED OXYGEN
1965 —— 1966 - - -
DISSOLVED OXYGEN - mg/l.
12
10
8
6
4
2
0
J
F
M
A
M
J
J
A
S
O
N
D

Figure 90

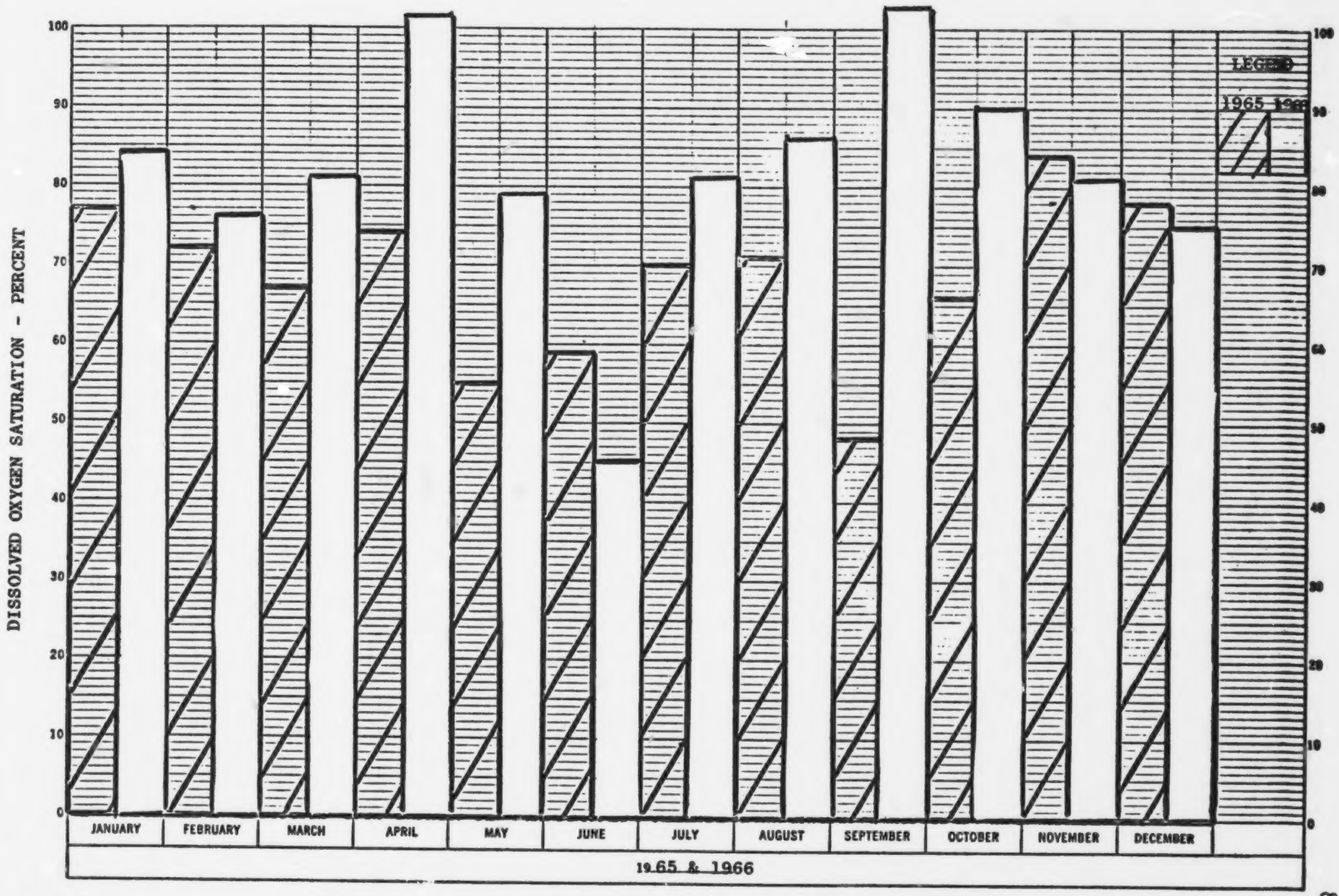


Figure Monthly Mean Dissolved Oxygen Saturation Levels - Des Plaines River at Lemont

Figure 91

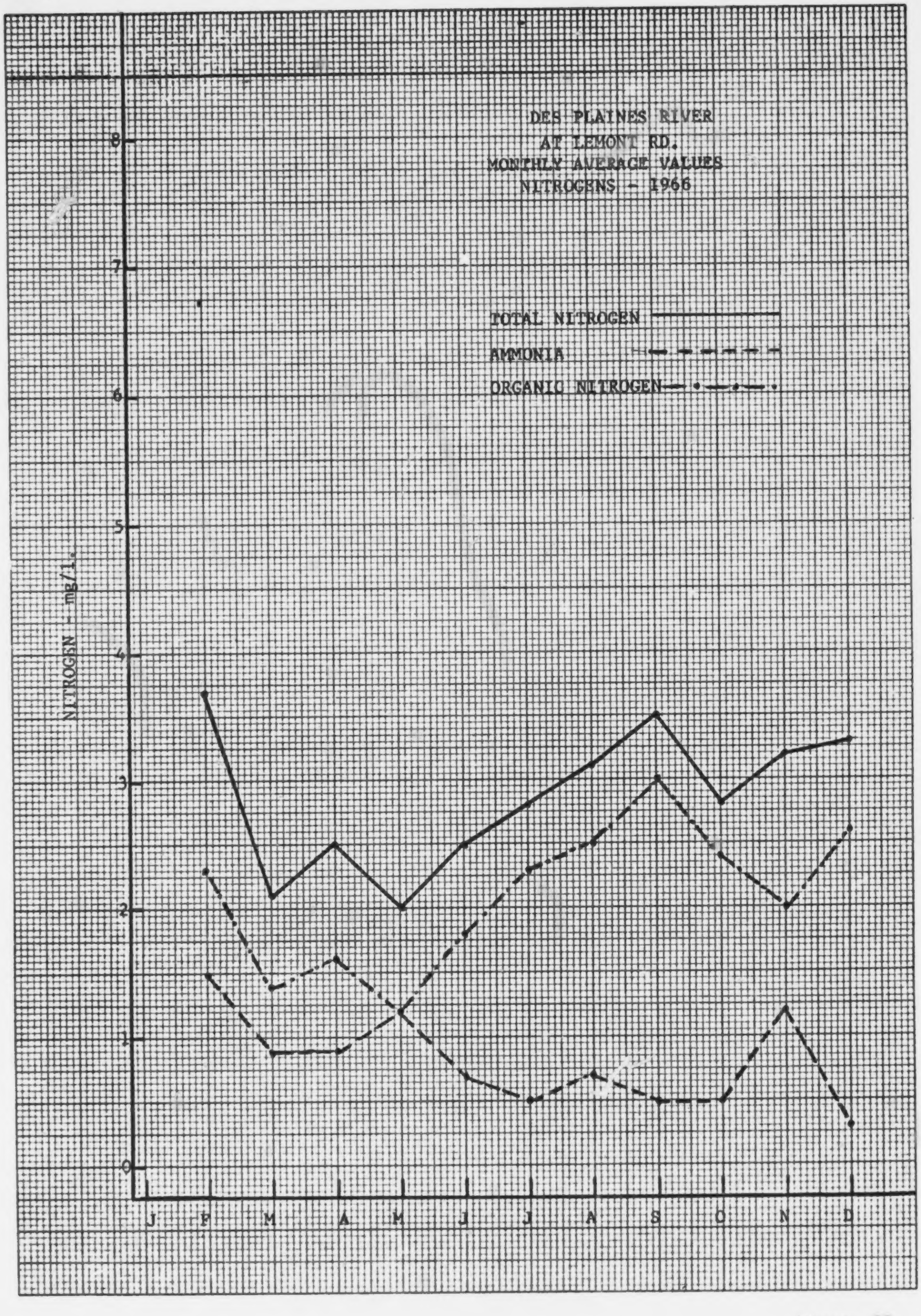

DES PLAINES RIVER
AT LEMONT RD.
MONTHLY AVERAGE VALUES
NITROGENS - 1966
TOTAL NITROGEN
AMMONIA
ORGANIC NITROGEN
NITROGEN - mg/l.
0
1
2
3
4
5
6
7
8
J
F
M
A
M
J
J
A
S
O
N
D

Figure 92

Inter Office Memorandum

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

DEPARTMENT MAINTENANCE & OPERATION

TO: Mr. Vinton W. Bacon, General Superintendent

DATE: March 14, 1967

FROM: Mr. Leo R. Peller, Asst. Chief of M & O (Maintenance)

SUBJECT: CHRONOLOGICAL SURVEY OF HELICOPTER SURVEILLANCE OF WATERWAYS SYSTEM

The following is a chronological listing of all helicopter inspection trips made since the inception of the program on February 12, 1965. Attached is a typical flight log sheet which includes all pertinent information concerning the section covered.

FLIGHT NUMBER	DATE	SECTION
1	February 12, 1965	North and South (orientation flight)
2	March 12, 1965	North
3	April 27, 1965	North and South (2 flights)
4	June 8, 1965	North
5	July 2, 1965	North and South (2 flights)

V. W. Bacon

FLIGHT NUMBER	DATE	SECTION
6	July 30, 1965	North
7	August 23, 1965	South
8	September 28, 1965	North
9	October 27, 1965	South
10	November 24, 1965	South
11	December 22, 1965	North
12	January 18, 1966	South
13	January 28, 1966	North
14	February 25, 1966	South
15	March 25, 1966	North
16	April 29, 1966	South
17	May 27, 1966	North
18	June 3, 1966	South
19	June 30, 1966	North
20	July 19, 1966	South
21	August 4, 1966	South
22	August 12, 1966	North
23	August 25, 1966	South
24	September 9, 1966	North
25	October 5, 1966	South
26	October 26, 1966	North
27	November 15, 1966	South

FLIGHT NUMBER	DATE	SECTION
28	November 30, 1966	North
29	December 23, 1966	South
30	January 12, 1967	North
31	February 17, 1967	South
32	March 13, 1967	North

Respectfully submitted,

(Signed) Leo R. Peller

Leo R. Peller

Assistant Chief of Maintenance

and Operation (Maintenance)

LRP:rg

HELICOPTER FLIGHT NO. 24 **HELICOPTER - SHEET** AREA COVERED North Section

DATE September 9, 1966 WEATHER CONDITIONS Fair-Clear 80° DEPARTURE 2:30 P.M. RETURN 4:30 P.M.

OBSERVERS J. Deneck - M. DeMichael PILOT R. Allendorfer COMPANY Chicago Helicopter Airways

STREAM	COMPANY	PLANT DISCH.	STORM SEWER	CONTROL CHAMBER	DEBRIS	LOCATION	REMARKS
M. Chan.	Unknown		X			East bank (between crawford & Lawndale)	Oil - Grey
M. Chan.	Edison	X				Fisk St. Station	Grey
N. Bran.	Boutcher Rendering	X					Colored Discharge
N. Bran.	Proctor Gamble			X			Suds
N. Bran.	Medill Incinerator	X					Bad Grey
N. Bran.	N.S. Treat. Plt.	X					Oily white scum traceable for two miles
N. Bran.	Rock Rd.	X					Brown Discharge
DesPlaines	Willow Rd.				X	Construction Site	Heavy Debris
DesPlaines	Higgins Garbage dump	X					Discolored
DesPlaines	Lawrence Ave.				X	Bridge	Heavy Debris
N. Bran.	Material Serv. Yd.	X					Colored outfall low flow

MARY: Main Channel - Flowing oil apparently from barges

N. Branch - Bad - North upstream from Wolf Point.

DesPlaines - very low - hardly any flow

Silver CK & Addison - Accumulation of oil at various points

HELICOPTER FLIGHT NO. ______ **HELICOPTER 1 SHEET** AREA COVERED: North Section

DATE September 9, 1966 WEATHER CONDITIONS Fair - Clear 80° DEPARTURE 2:30 P.M. RETURN 4:30 P.M.

OBSERVERS J. Dencek - M. DeMichael PILOT R. Allendorfer COMPANY Chicago Helicopter Airways

STREAM	COMPANY	PLANT DISCH.	STORM SEWER	CONTROL CHAMBER	DEBRIS	LOCATION	REMARKS
Silver Ck.	5th Ave.		X			Bridge	Suds
Silver Ck.	15th Ave.		X			Bridge	Oil
Silver Ck.	Armitage Ave.		X			Bridge	Multicolor Oil
Addison Ck.	International Paper	X				Rear of Plant	Red Colored - Oily

MMARY:

EXHIBIT "F" RFL - 3-14-67

O'Brien Lock and Dam Operation

The Waterways Control Section of the Sanitary District controls the hydraulic operation of the O'Brien Lock and Dam to cause a continuous flow of water in the Calumet River away from Lake Michigan. This is done by opening the sluice gates at the Lock to predetermined settings depending upon the water levels above and below the Lock. Telemetering of the water levels to the Waterway Control Center in our downtown office allows for continuous monitoring of the water levels and making changes to effect a constant flow.

The year 1966 is a prime example of this operation. The monthly flows at the Lock are as follows:

J - 150 cfs
F - 170 "
M - 470 "
A - 260 "
M - 190 "
J - 240 "
J - 270 cfs
A - 340 "
S - 380 "
O - 370 "
N - 570 "
D - 610 "

average - 340 cfs

During 1966, extensive by-passing to the Calumet River at Howard Slip was done by the 95th Street Pumping

Station. In the month of March a blockage in the discharge sewer at the pumping station was detected and sewage was by-passed a considerable part of the time. Increased by-passing occurred throughout the year due to the blockage until the blockage was removed in December. The flows by-passed are as follows:

J - 0 cfs
F - 0 cfs
M - 17.0 "
A - 1.2 "
M - 5.7 "
J - 4.2 "
J - 5.7 cfs*
A - 0.2 "
S - 0 "
O - 1.4 "
N -22.1 "
D -32.2 "

average - 7.5 cfs

Note: *Chlorination of by-passing began at the pumping station in July 1966.

At the minimum, discharge at the O'Brien Lock was 19 times the by-passing at the pumping station (December).

This type of operation insures that undesirable wastes discharged to the waters of the Calumet River are continuously moved downstream away from Lake Michigan.

* * * * *

EXHIBIT "G"

E.I.R. 3-13-67

STATUS OF CALUMET INDUSTRIES

March 13, 1967

UNITED STATES STEEL CORPORATION

The following has been accomplished:

1. Oil Skimmers

One (1) belt type oil skimmer installed and operating at the North Slip - December 1965.

A second oil skimmer has been purchased for the No. 5 outfall sump and installation is expected to be completed April 1967.

2. Blast Furnace Slag Pits

No. 10 Blast Furnace: Wet sluicing granulating type slag pit converted to dry type air cooled slag pit completed and in operation - April 1966.

No. 2 Blast Furance: Preliminary engineering completed for converting wet sluicing granulating type slag pit to dry type air cooled slag pit. Estimated date of completion - December 1967.

No. E Blast Furnace: Preliminary engineering and detail engineering completed for converting wet sluicing granulated type slag pit to dry type, air cooled slag pit. Estimated date of completion - December 1967.

No. 8 Blast Furnace: A dry type, air cooled slag pit is included in the preliminary design of a new No. 8 Blast Furnace. Estimated date of completion - December 1968.

3. Continuous Pumping Facilities at Dorr Thickeners

Two (2) new lift pumps are installed and operating - February 7, 1967.

4. Water Pollution Control - Step I

Preliminary engineering is completed and funds authorized for additional facilities to recover solids in blast furnace waste water. The facilities will consist of a lift pump station, two (2) 110 foot diameter thickeners with 4-1/2 to 5 hours retention time, sludge pumping facilities and three (3) vacuum sludge filters. Construction for this project will require 15-18 months and when completed will result in a major improvement in pollution control, removing substantially all the flue dust from the 1, 2, 4 and E Blast Furnace Gas Washer Water. The Metropolitan Sanitary District is currently evaluating these facilities.

5. Water Pollution Control - Step II

An outside engineering firm was engaged November 1966, and is presently in the process of studying the plant sewer system. The completion of this report will be the first phase of a study to determine what will be required of the industrial waste system to meet minimum requirements of industrial waste treatment.

6. New Basic Oxygen Process Steelmaking Facilities

Preliminary engineering is completed. Design and detail engineering is in progress for the treatment of gas scrubbing water. The facilities will consist of recycling of scrubber water, a 115 foot diameter thickener with approximately 11 hours retention time and sludge filtering equipment. Furnace hood cooling water will be reused utilizing an induced draft cooling tower. Estimated date of completion is scheduled for December 1967. The Metropolitan Sanitary District is currently evaluating these facilities.

7. Sampling of Industrial Outfalls

The program for the sampling and reporting of analyses of their industrial waste discharged is being maintained.

WISCONSIN STEEL DIVISION, INTERNATIONAL HARVESTER COMPANY

The following has been accomplished:

1. Internal Improvements

Good housekeeping programs have been established and rigidly followed. Reports of all plant wastes discharged to the river are submitted on a weekly basis to the Works Manager's office.

Incorporation of a sampling and analyzing program of all waste water discharges.

Development of a continuous maintenance program of facilities to prevent and/or minimize pollution.

2. Boiler Water Softening Plant

Installation of sump and appurtenant facilities to re-route boiler blowdown to one of the existing thickeners. Previously this waste was discharged directly to the river without subsequent treatment.

3. Thickeners

Installation of improved slurry pumps. Outfalls numbers 5 and 6 have been re-routed to the Thickeners. Previously these wastes were discharged to the river without subsequent treatment. Effluent from the clarifiers are re-circulated back into the system.

4. Coke Plant

Have obtained an appropriation to study the feasibility of re-circulating coke plant effluent (outfalls #11, 13, & 14) into the system. The order for this study has been placed. The appropriation includes the re-building of a portion of the Coke Plant. Estimated completion date - July 1968.

INTERLAKE STEEL CORPORATION - RIVERDALE PLANT

Preliminary engineering plans have been submitted to The Metropolitan Sanitary District during November 1966. These plans depict the following waste treatment facilities used to abate water pollution:

1. Cold Mills

An oil de-emulsification system is included.

2. Hot Mills

Two (2) belt type oil skimmers for scale pits included.

Inlet and outlet baffles for 2 scale pits included.

3. Pickling, Metal Plating & Boiler House Installations

Provisions for neutralization, oxidation and clarification systems included.

Final engineering scheduled for approval before April 30, 1967, with all systems installed and operational before December 31, 1967.

4. Other Accomplishments

Use of coagulant aids at both mills has improved clarifier effluent quality considerably.

Installation of new sewerage system at Riverdale diverted all sanitary wastes to the local sewer.

Added new personnel for pollution control.

Improved housekeeping and in-plant control.

INTERLAKE STEEL CORPORATION - CHICAGO PLANT

Preliminary engineering plans have been submitted to The Metropolitan Sanitary District during December 1966. These plans depict the following waste treatment facilities used to abate water pollution:

1. Blast Furnace Plant

Modification of existing thickener with flocculation, cyanide destruction and re-circulating facilities.

2. Coke Plant

Installation of a piping system which will discharge phenolic, cyanide and ammonia wastes to the Sanitary Sewer.

Final engineering scheduled for approval before October 31, 1967, with all systems installed and operational before June 30, 1968.

REPUBLIC STEEL CORPORATION

The following has been accomplished:

1. 14" Mill

The new 14" Bar Mill is nearing completion, and it is anticipated that this mill will be in operation during the third quarter of this year. More than $500,000 is being spent on water treating facilities in connection with this installation.

The 14" Mill's pollution abatement facilities consist of two scale pits with automatic and continuous oil and scale removal facilities. Effluent from the pits is recycled for scale flushing in the mill. A complete water treatment plant is being constructed to treat a portion of the scale pit water, to a higher quality for certain uses on the mill.

All cooling for the furnaces, air compressors and related facilities is handled through a separate system, passing through cooling towers, and continuously reused. Blow down from this system will be to the mill scale system.

Although the water demand on this mill will be in excess of 8,000 gallons per minute, the discharge will be limited to 300-400 gallons per minute of coagulated and clarified effluent.

2. Waste Pickle Liquor

Wheelabrators have been installed in various locations to remove the scale from the bars by grit blasting as a replacement for the acid pickling operations. Units installed in the 11, 12, and 32" mills have replaced five large pickle tanks reducing the acid usage.

This use of Wheelabrators has reduced the use of sulphuric acid for pickling by an estimated 65 percent of the total formerly used.

In addition, all of the spent pickle liquor from the Continuous Coil Anneal and Wire Mill which was formerly discharged to the river is now being hauled from the plant by an outside contractor, and averages in excess of 500,000 gallons per month.

3. Blast Furnace Dust

Solids from the blast furnace gases are removed through a series of gas cleaning devices. Waste water from the gas washer and precipitator are transferred to a thickener for treatment prior to being discharged to the river.

The thickener is 105 feet in diameter and has a retention time in excess of four hours. Mechanical scrapper and a slurry pumping system carry the sludge to the Sinter plant for reuse in the blast furnaces. Provisions have been made to direct the waters to a settling pond at the ore dock in the event of mechanical difficulties with the thickener. This prevents any direct discharges of untreated wash water from being discharged to the river.

A new heavy duty rake assembly with scum removal equipment is on order for the thickener, which will improve the dependability and efficiency of the unit. Delivery of the unit will be 12-14 months and will be installed upon receipt of the equipment.

4. Recirculating Water

Water is now being recirculated in three different locations, namely, the Blast Furnace - Coke Plant, Open Hearths and Bar Mill Reheat Furnace. The volume of water reused in these operations amounts to 30 million gallons per day. All cooling water used in The Open Hearth Furnaces is recirculated. This amounts to 28 million gallons per day, formerly taken from the Calumet River. Cooling water for the 11" Bar Mill Reheat Furnace is recirculated in a manner similar to that used in the Open Hearth shop.

From this it is obvious that water conservation is a basic policy in the water management program.

5. Scale Pits

All scale produced in the various rolling mill operations is transfered to sedimentation tanks. There are a total of 16 sedimentation tanks used for the recovery of scale and oil. Modifications have been made in the older basins to improve the efficiency of scale and oil removal.

The 11" Mill is equipped with automatic and continuous scale removal and a new continuous belt type oil skimmer is in operation on this unit. The flume from the 10" Mill has been connected to the 11" Mill scale pit to utilize the facilities of the automatic scale pit.

6. Sanitary Waste

All of the sanitary waste in the Chicago District are discharged directly into the Sanitary District sewer lines and none goes to the Calumet River.

7. Coke Plant

The only water discharged to the Calumet from the Coke Plant is that used for cooling and does not come in contact with the waste streams. Waste waters containing ammonia, cyanides, and phenols are pre-treated prior to discharge to the Sanitary Sewer System.

8. Air and Water Management

The Chicago District is a pioneer in establishing a department solely for the purpose of air and water management.

This department was established in 1966 and comprises the departments formerly under Combustion, Steam Production, and Mechanical Departments.

Engineers are assigned to a continuous program of inspection and education on supervisors of the operating departments in good housekeeping and water management. The department correlates all of the activities of the chemical laboratory, engineering, operations, and maintenance in connection with the design and installation of water pollution control facilities.

More than 2-1/2 million dollars have been spent on pollution abatement facilities in the Chicago District since 1958, illustrating Republic's awareness of water pollution control.

CATALIN CORPORATION

Company installed temporary lagoons to handle process wastes which were separated from their cooling water. Analyses disclosed remaining effluent not of adequate quality. Company did not fully cooperate with The Metropolitan Sanitary District to resolve remaining problem and were called in for a Show Cause hearing in January 1967. Since the hearing the company has fully cooperated with the Metropolitan Sanitary District and have accomplished the following:

1. Plans for a sanitary sewer extension to divert all concentrated process wastes to a Metropolitan Sanitary District interceptor have

been submitted to The Metropolitan Sanitary District and approved. Construction phase of this project sewer contemplated by March 17, 1967. This system will discharge all process wastes to Metropolitan Sanitary District facilities.

2. Developed plans for a new condensing system to prevent the discharge of steam entrained pollutants to the river. The new equipment is on order and being fabricated. Shipment scheduled for April 10, 1967.

FORD MOTOR COMPANY

Company has completed the installation of all waste treatment facilities in February 1967 deemed necessary to comply with Metropolitan Sanitary District requirements. Minor adjustments are under way to facilitate operation of their acid treatment system. In addition, the continued program of good housekeeping is being maintained to eliminate contaminants from being discharged to the river. Company has no plans for any additional waste treatment installations, since it is their belief that the operation of the existing facilities in conjunction with good housekeeping will provide the degree of control to conform to the water been submitted to The Metropolitan Sanitary District and approved. Construction phase of this project sewer contemplated by March 17, 1967. This system will discharge all process wastes to Metropolitan Sanitary District facilities.

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BULK TERMINAL COMPANY - LAKE CALUMET

Company installed a secondary waste water treatment facility during February 1967, which is currently operational. Their routine monthly analyses indicates that the waste treatment facility is not performing at expected efficiency. Industrial Waste Control Division to evaluate effluent within 30 days.

GULF OIL CORPORATION

Company is using an earthen dike sludge pond for the storage of process wastes. This facility is inspected once per shift to prevent any leakage to the river. A private scavenger has been retained to pump out ponds when they reach capacity. Occasional river discharges due to pond leakage after intense rainfall.

They have entered into an agreement with the Catalin Corporation to install a sewerage system to convey their wastes to a Metropolitan Sanitary District sewer in Calumet City. Construction of this project scheduled for

March 17, 1967. This system will discharge all process wastes to The Metropolitan Sanitary District facilities.

GENERAL MILLS, INC.

Company has diverted all contaminating wastes to the Sanitary Sewer. Only cooling water is discharged to the river. Final correction completed during latter part of 1966.

UNITED CHEMICAL CORPORATION

Industrial Waste Control Division observations and surveillance show no process wastes being discharged into the river.

CARGILL, INC.

Industrial Waste Control Division's evaluation indicates that the company's new waste control facilities and good housekeeping programs still eliminate the discharge of any wastes to the river.

ALLIED CHEMICAL CORPORATION - INDUSTRIAL CHEMICAL DIVISION

The company still maintains effluents that meet the minimum requirements set forth in The Metropolitan Sanitary District directive of August 18, 1965. To insure their continuing to maintain satisfactory conditions, they have increased the frequency of their sampling monitoring program. In addition, they have instituted a formal program to prevent accidental spills of process materials.

SWIFT AND COMPANY

Industrial Waste Control Division observations indicated occasional discharges to the river, due to lagoon leakage. The lagoons have been reinforced, eliminating this problem.

CHICAGO BRICK COMPANY

Company has discontinued discharging waste effluent to the river. This has been achieved through in-plant control and incorporation of good housekeeping.

LIBBY MCNEIL AND LIBBY

Since this company has diverted their process wastes to the local sewerage system, no wastes have been discharged to the river. Wastes are pre-treated prior to their discharge to the sewer.

GENERAL

All industry in the Calumet Area have been kept under constant observation and/or surveillance by the Industrial Waste Control Division. This consists of routine inspections and helicopter observations. In general, our observations have shown a marked improvement of the effluents discharged to the waterways in this area.

All industries discharging to the waterways in this area, regardless of volume of flow and/or type of wastes created, must continuously submit routine effluent analyses, on a monthly basis, to the Research and Control Department for review of representative analytical data.

* * * * *

EXHIBIT "H"

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

DEPARTMENT OF RESEARCH AND CONTROL

IWC DIVISION

OFFICE MEMORANDUM DATE: March 14, 1967

TO: Mr. Vinton W. Bacon, General Superintendent

FROM: Earl I. Rosenberg, Coordinator - Industrial
Waste Control

SUBJECT: HEW CONFERENCES

The conferees adopted the following maximum time schedule for control of waste discharges of industry during the executive session of January 31, and February 1, 1966:

1. Preliminary engineering planned documents completion - December 1966.
2. Final engineering plans documents completion - June 1967.
3. Construction completion with facilities in operation - 1968.

These documents are to be filed in sufficient time so that they may be approved by The Metropolitan Sanitary District in conformance to the aforementioned dates.

The conferees recognize that modifications in this schedule may be necessary and these may include:

1. A lesser time when the Metropolitan Sanitary District considers a practical method of control can be in operation prior to the time stated.

2. In a few industries some variations from this schedule may be sought from the Metropolitan Sanitary District. In such cases, after review, the conferees may make appropriate recommendations to the Secretary of the Department of Health, Education and Welfare.

The following tabulation depicts the current status of the Calumet industries in respect to the maximum time schedule:

UNITED STATES STEEL CORPORATION

Preliminary engineering plans completed for the majority of their waste control facilities. Construction of some of their waste control facilities have been completed and are operating. An outside consulting engineering firm is working up preliminary plans to determine what will be required of the industrial waste treatment systems to meet minimum requirements of the industrial waste treatment.

WISCONSIN STEEL COMPANY - INTERNATIONAL HARVESTER

Preliminary engineering completed for most of their abatement facilities. Preliminary engineering plans now being developed for their recirculation facilities. Construction of some of their waste control facilities completed and are operating.

INTERLAKE STEEL CORPORATION - RIVERDALE PLANT

Preliminary engineering plans completed. Installation of new sewage system diverting all sanitary wastes to the local sewers have been completed. Some of the waste treatment abatement facilities completed and are operating.

INTERLAKE STEEL CORPORATION - CHICAGO PLANT

Preliminary engineering plans completed.

REPUBLIC STEEL CORPORATION

Some phases of their preliminary engineering plans have been completed. Construction of some of their waste control facilities completed and are operating.

CATALIN CORPORATION

Preliminary plans have been completed. Construction completed of temporary facilities which are in operation.

FORD MOTOR COMPANY

Preliminary engineering plans completed. Final engineering plans completed. All construction completed and the majority of their waste control facilities are in operation.

BULK TERMINALS COMPANY

Preliminary plans completed. Final engineering plans completed. Waste treatment facilities constructed and in operation.

GULF OIL CORPORATION

Preliminary engineering plans completed. Construction of temporary waste control facilities completed and operating.

GENERAL MILLS, INC.

V. W. Bacon

Preliminary engineering plans completed. Final engineering plans completed. Construction completed and waste control facilities in operation.

CARGILL, INC.

Preliminary engineering plans completed. Final engineering plans completed. Construction completed and waste control facilities in operation.

ALLIED CHEMICAL CORPORATION - INDUSTRIAL CHEMICAL DIVISION

Preliminary engineering plans completed. Final engineering plans completed. Construction completed and waste control facilities in operation.

CHICAGO BRICK COMPANY

Preliminary engineering plans completed. Final engineering plans completed. Construction completed and waste control facilities in operation.

LIBBY, McNEIL AND LIBBY COMPANY

Preliminary engineering plans completed. Final engineering plans completed. Construction completed and waste control facilities in operation.

Our August 18, 1965 directive to the Calumet area industries provided the industries with minimum criteria until further standards could be adopted. The aforementioned is based on this criteria.

(Signed) Earl I. Rosenberg, Coordinator
Earl I. Rosenberg, Coordinator
EIR:fs Industrial Waste Control

* * * * *

CALUMET REGION
INDUSTRIAL WASTE ANALYSES

Company Gulf Oil Corporation, Chemicals Department
Address P. O. Box 178, Calumet City, Illinois
Identity of Sampling Point Laboratory and Floor Drain

Date Sample Obtained 8 a.m. 11-30-66 to 8 a.m. 12-1-66

Required	Parameter or Constituent	Results	Remarks
x	BOD (ppm)	20.6	
x	COD (ppm)	241	
x	pH	8.3	
x	Temperature (°F)	54	
x	Suspended Solids (ppm)	4	
	CL^- (ppm)		
	$SO_4^=$ (ppm)		
x	Total Hardness (ppm÷ $CaCO_3$)	130	
x	Alkalinity (total) (ppm÷ $CaCO_3$)	134	
x	Acidity (mineral) (ppm÷ $CaCO_3$)	0	
x	Settleable Solids (ml/l)	0	
x	Electrical Conductivity μmhos	342	
	Hexane Solubles (oils fats greases) (ppm)		
	Cyanides (ppm)		
	Iron (soluble) (ppm)		
	Manganese (ppm)		
	Phenols (ppb)		
x	Organic-N (ppm-N)	4.7	
x	NH_3-N (ppm-N)	4.5	
	Phosphates (total) (ppm÷ $PO_4^{\equiv}$)		
	Color (units)		

Flow during period corresponding to analytical data <1 gpm

Certified by T. M. Nairn T. M. Nairn Jr
Title Laboratory Supervisor
Date December 13, 1966
Firm Gulf Oil Corporation

Approved (Industry representative) R. W. McKinney R. W. McKinney
Title Works Manager

EXHIBIT "I"

EXHIBIT "J"

February 2, 1967

RESOLUTION

SETTING SCHEDULE OF PUBLIC HEARINGS AND MEETINGS FOR ADOPTING WATER QUALITY CRITERIA FOR INTERSTATE AND OTHER WATERS UNDER THE JURISDICTION OF THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

WHEREAS, The Federal Water Pollution Control Act provides, in part:

"Section 10 ....(c) (1) If the Governor of a State or a State water pollution control agency files, within one year after the date of enactment of this subsection, a letter of intent that such State, after public hearings, will before June 30, 1967, adopt (A) water quality criteria applicable to interstate waters or portions thereof within such State, and (B) a plan for the implementation and enforcement of the water quality criteria adopted, and if such criteria and plan are established in accordance with the letter of intent, and if the Secretary determines that such State criteria and plan are consistent with paragraph (3) of this subsection, such State criteria and plan shall thereafter be the water quality standards applicable to such interstate waters or portions thereof.

4

"(2) If a State does not (A) file a letter of intent, or (B) establish water quality standards in accordance with paragraph (1) of this subsection, or if the Secretary or the Governor of any State affected by water quality standards established pursuant to this subsection desires a revision in such standards, the Secretary may, after reasonable notice and a conference of representatives of appropriate Federal departments and agencies, interstate agencies, States, municipalities and industries involved, prepare regulations setting forth standards of water quality to be applicable to interstate waters or portions thereof. If, within six months from the date the Secretary publishes such regulations, the State has not adopted water quality standards found by the Secretary to be consistent with paragraph (3) of this subsection, or a petition for public hearing has not been filed under paragraph (4) of this subsection, the Secretary shall promulgate such standards."

WHEREAS, the Metropolitan Sanitary District of Greater Chicago did on March 7, 1966, in a letter to the Secretary of Health, Education, and Welfare, declare its intentions to set water quality criteria in conformance with the Federal Water Pollution Control Act,

NOW, THEREFORE, BE IT RESOLVED that the Metropolitan Sanitary District of Greater Chicago sets the following schedule of public hearings and meetings for adopting water quality criteria and a plan for implementation and enforcement of the water quality criteria for interstate and other waters under the jurisdiction of the Metropolitan Sanitary District of Greater Chicago.

1) Public hearing on present and future beneficial
   water uses of
   Lake Michigan
   Calumet River and tributaries
   Chicago River and tributaries
   Des Plaines River and tributaries
   Sanitary and Ship Canal
   North Shore Channel
   Cal-Sag Channel
   at 10:00 a.m., March 3, 1967.
2) Public meeting of Board to adopt present and future beneficial water uses to be protected in waters listed above in Item 1 at 10:00

a.m., April 7, 1967.

3) Public hearing on water quality criteria and a plan for implementation and enforcement to protect present and future beneficial water uses adopted under Item 2 above at 10:00 a.m., May 5, 1967.

4) Public meeting of Board to adopt water quality criteria and a plan for implementation and enforcement of the criteria at 10:00 a.m., June 2, 1967.

BE IT FURTHER RESOLVED that all public hearings and meetings shall be held in the Board Room, Headquarters Building, The Metropolitan Sanitary District of Greater Chicago, 100 East Erie Street, Chicago, Illinois, 60611.

BE IT FURTHER RESOLVED that organizations and individuals be furnished a copy of this Resolution and be invited to attend all public hearings and meetings and to submit written statements setting forth their views.

Resolution Adopted at the February 2, 1967,
Meeting of the Board of Trustees
The Metropolitan Sanitary District of Greater Chicago

* * * * *

MR. STEIN: Are there any comments or questions?

MR. POOLE: I have one for my enlightenment. It doesn't particularly help the record.

What kind of retention time do you have for that chlorination at that 95th Street Station?

MR. BACON: In the slip?

MR. POOLE: I gather that is where the retention was, in the slip.

MR. BACON: It varies between the pumps. It will be somewhere between one hour to six or seven hours.

MR. POOLE: I see. In other words, it is a pretty long time?

MR. BACON: Yes. It is 100 feet wide, 700 feet long, and about 20-some-feet deep. With the storm pipes and the dry weather pumps, it will be a little less than an hour, as I recall.

We have good chlorine contact time and sufficient settling, so that we are probably dropping out most of the settleable solids. I don't know what state we are in now for the skimming device, but we are planning a skimming device for the area also.

Literally, we will be having primary treatment with heavy chlorination.

MR. STEIN: Any other comments?

MR. KLASSEN: Just along that same line, just from a purely technical information standpoint, what kind of chlorine demands do you get? In other words, how much do you feed relatively?

This is an interesting setup because of the relatively long length of contact time. I wondered whether perhaps we could discuss it later and not take the time here, but I was just interested from a technical standpoint.

MR. BACON: We have not become that sophisticated with this flow yet. We are using about 40 parts per million of chlorine, using sodium hypochlorite. Under these circumstances, the cost of the chemical is not a controlling factor.

I might volunteer that this has been encouraging. They were going to put an identical installation at the North Side Sewage Treatment Plant for chlorination of that effluent with about seven and a half minutes detention with forced gravity means to the North Shore Canal, and then see what can be done in the canal itself as the contact basin. It would save us millions of dollars in a couple of years if this works.

MR. STEIN: Are there any further comments or questions?

MR. POSTON: Mr. Bacon, in the South Works of the United States Steel Corporation, what kind of a date are you shooting for in terms of completion of waste treatment works?

MR. BACON: Right now we would probably state that they are about six months behind schedule. That is about the best we can fix it.

Neither the president nor I were involved in any way whatsoever in the program up until just recently. I am speaking of President Egan. We have recently come aboard on this industrial waste problem.

I am going to say a word for United States Steel, because I think that there is a vast difference between when you are talking about the Gary Works and the South Works. I don't know how it is in the manufacturing of steel, but it seems to me that in the water problem there is a difference, and it is because of this.

I am going to use this chart for just a minute.

When O'Brien was put into operation, this made this a lake (indicating). In other words, when the locks are not working, are not operated, or when the sluice gates are not opening, this, for all practical purposes, is a lake. It is a very slowly moving lake.

It used to be when the lock was over here (indicating) that the flushing all took place in this direction at times, during storm and other times, but with the building of the O'Brien Lock, now we have complete control, except for minor circumstance, over this waterway.

Part of our program, as I have pointed out, has been that we maintain an average of 350 cubic feet per second in this action, and therefore we are pulling the wastes this way (indicating) at all times during the critical part of the year, and we hit it practically all of last year.

So, when we are not drawing that way, what is the position of United States Steel? The position of United States Steel South Works is that they draw water out of the lake and go through this plant. We don't care whether they put it in the river right here (indicating) or back in the lake. It is in essence back in the lake, and they have to make those stringent requirements for the lake which are considerably higher than the requirements for here (indicating) That is why I asked that question, in anticipation of this explanation.

Do you follow me, Mr. Stein or Mr. Poston?

MR. STEIN: I have no trouble (indicating).

MR. BACON: This is actually a cycle here, and, therefore, they are going to have to meet right at the shore the criteria set by this conference, and those are tough criteria to meet. We think their problem is so extremely complicated and going to be so costly that we want to take a little more time too.

MR. STEIN: Yes.

Well, here you have talked about 16 industries, Mr. Bacon. Do I understand your report that 13 of these are on schedule and they are going to be completed by December of 1968 and in operation?

MR. BACON: They are on schedule now as far as the preliminary plans are concerned, and from what appears to be, they will meet the schedule for the final engineering.

If they will fall down between now and the end of 1968, we don't know, but we are not anticipating that they will.

MR. STEIN: But, as far as we know, they are on schedule?

MR. BACON: Yes, sir.

MR. STEIN: And the other three steel plants, the large steel companies -- you didn't say three, did you?

MR. BACON: Yes, we did. We said the three.

MR. STEIN: Three are a little behind?

MR. BACON: As far as we can determine now, we would say six months.

MR. STEIN: Well, even with six months behind, if they run six months behind and we have a date of December 1968 for it to be in operation, six months behind would make it July, say, or the end of June 1969, which would still be ahead of what United States Steel said they were going to do in Gary.

MR. BACON: I did not mean to imply that we are extending that to the construction. I am talking about the thing that we set the dates for, the plans and engineering, and right now we would say they are that far behind on the plans and engineering.

MR. STEIN: We understand that, but what I am trying to get at is, is this an accelerating operation, or do you feel that just the six months won't accelerate it?

They are six months behind here. There shouldn't be any indication that that six months should expand in the future, should it?

MR. BACON: Mr. Stein, until we get their plans and specifications, we have not asked them what the minimum timetable can be on that construction.

As of now, we are assuming it can come close to that schedule. They may come to us, as they did to the other members of this conference, and say that they need more time. We have not asked that question yet.

MR. POOLE: This may be an unfair question. If it is, I will withdraw it, but --

MR. BACON: Go ahead and withdraw it.

(Laughter.)

MR. POOLE: You have listened to me and, I am sure, you know pretty generally the problem of your steel mills which you are discussing now.

Do you think we have been talking in too unrealistic terms today?

I say I will withdraw it if you think it is an unfair question.

MR. BACON: I think that is a conference decision, Blucher.

I think all of us have individual professional opinions on this, and opinions as to the reality of some schedule. I think that is a conference decision.

MR. POOLE: Good answer, as usual.

MR. BACON: I want to make another comment.

When you talk about those 13 that are on schedule, we had to cite one of them in for a show-cause hearing, and it was a full show-cause-on-the-way-to-court hearing, and then they promptly got on schedule, so we are going to use our teeth when it is timely.

One of those 13 did not come easily by the schedule.

MR. STEIN: Let me again, Mr. Bacon, go over this. This is for clarification.

The December 1966 deadline was for preliminary plans and specifications. They did not do this. Now, if we have six months, that will be June 30, 1967, but your sentence says it is doubtful that the large steel companies will complete preliminaries by June 30, 1967.

If they are going to be about six months behind, at least to me it would seem they should complete it by June 30, 1967. Does this indicate that they are going to be more than six months behind?

MR. BACON: I don't know. You can't cross the bridge until you get to it.

Although I was trying to illustrate to you, since the endorsement of this was up to us in the District, if this gets behind and we think it is not realistic, we are going to move on it, just as we did on company No. so-and-so.

MR. STEIN: I recognize that, but what I am trying to do is understand what you said, and the position.

The point is, if they are running six months behind, then the preliminary plans should be completed by June 1967. If they are completed by June 1967, then I am not sure, and I am asking for clarification, what the sentence means where you say, "It is doubtful if the large steel companies will complete preliminary plans by June 30, 1967."

MR. BACON: This is our prediction, that the way it is going they may not even complete their preliminary plans by that time.

MR. STEIN: In other words, they are more than six months behind?

MR. BACON: Yes, they will be then more, if that happens; but, as I pointed out to you, the pressure that is being brought to bear will be brought to bear even more intensely.

MR. KLASSEN: This is just a technical question, Mr. Bacon, but have you found in your Calumet River -- you indicated how much like a lake it is -- that wind directions affect possible reversals, water going one way underneath and another way on top?

I think you mentioned that at the last hearing. What has been your experience?

MR. BACON: Right now, we just don't have devices sophisticated enough to measure whether it is reversing or not, although we believe we are going to be able to acquire it, but what will happen if you have three or four per second feet flowing in this direction (indicating) if the wind suddenly reverses and goes offshore and drops the lake by a foot, then from somewhere back in here out to there you have a slope of about a foot, maybe over a half mile or over a mile, so all the water that would flow in that direction would not be the entire body, but the equivalent of that thin wedge.

We just don't know how much that would be, and, of course, from a practical point too, we can't set this in motion fast enough to overcome a wind. It takes quite a few hours to get an increased diversion to be felt way back at the mouth of the river.

MR. STEIN: Are there any further comments or questions?

(No response.)

MR. STEIN: If not, thank you very much, Mr. Bacon.

In talking to the conferees, we feel that we may be pretty close to an announcement. We will recess for about ten minutes.

If we find we are hitting any snags, we will send word out, but if the conferees will go in through that door to my right, we will confer, and I hope we will be out very shortly.

(Whereupon a recess was had.)

CLOSING STATEMENT

BY

MR. MURRAY STEIN

MR. STEIN: May we reconvene?

I am happy to say that the conferees have come to a unanimous conclusion.

I will attempt to summarize the conclusion orally, and then, of course, allow the conferees the opportunity to suggest any modification or nuances I may not have caught inside, so that we can have a complete record on the matter.

We all believe that considerable progress has been made towards abating pollution, both by the municipalities and the industries concerned. I think the progress here is in full flight. We are having as much progress as you can have in any area of a clean-up program, and I think those of us who are professionals in the field can sense when there is a clean-up program under way, and that is under way here.

We also recognize the difficulty that some of the municipalities and industries are having in meeting the time schedules, and because of the nature of the water and, I think, the conscientiousness of the technical staff, both the water quality requirements and the treatment requirements and the time schedules, as you can appreciate, are rather tight.

As a matter of fact, the water quality requirements, except for certain kind of specialty waters such as Lake Tahoe, are probably as high as you will find anywhere in the country.

Recognizing this, and recognizing that the State agencies and all of us under other aspects of the program have to establish action programs for all waters, the conferees have unanimously agreed that for the present time there will be no change in the time schedule which has been previously announced.

However, the conferees have scheduled another progress meeting for September 6th of this year in Chicago.

At that time, the conferees will have the benefit of the State action programs, we hope, and will have the benefit of evaluating the progress of the industries and the municipalities in this area.

We recognize that many of the industries and municipalities are making a valiant effort to meet the time schedule established by the conferees and the water quality requirements established by the conferees.

I think it behooves them to demonstrate in the next six months that they are making this effort. If what has to be done is the development of engineering plans, the job is to go out and get consulting engineers, or other technical staff, and get it.

The conferees, of course, will consider the progress at the September 6th meeting, and the question of a reasonable date of compliance will be opened for discussion at that time. I think we will be in a much better position to make the judgment on reasonable dates of compliance when we have all the facts that the State program and the District are going to develop in establishing action programs and standards between now and that time, and, just as important, by evaluating the progress that the industries and municipalities have made.

If they have made a bona fide attempt to move their program forward as rapidly as possible, and this very well will show up by September, we will again reconvene and determine how far ahead we have to move in order to keep the program on schedule.

The present schedule is being maintained so that we will give all the dischargers every opportunity to get on the track, and, of course, we will be sympathetic, but I think a good faith showing must be made in six months that they have made every attempt to move this forward.

In large measure, I think we should recognize that by and large the program is on schedule, and considering this to be a complicated municipal-industrial area, that takes second place to none in the complicated nature and the difficult technical nature of the problem, which is indeed an achievement.

As a matter of fact, I would say that given any major municipal and industrial program that I have been connected with -- and there have been quite a few -- the adherence to the schedule in the Chicago metropolitan area is at least as good as anywhere else, and perhaps better than most.

I will ask the conferees if they have anything to add.

MR. POSTON: I have no comment.

MR. KLASSEN: No.

MR. EGAN: No.

MR. POOLE: No.

MR. STEIN: If not, I would like to thank you all for coming and staying with us. I think we have achieved quite a lot.

We stand adjourned until September 6th.

(Whereupon, at 5:55 p.m., the conference was adjourned until September 6, 1967.)